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TO THOSE WHO WISH TO STUDY ELECTRICITY.

There is an ever increasing multiplication of electrical schools and electrical students in the United States. Doubtless the large majority of the young men who enter these institutions have in mind positions of responsibility, and look forward to their graduation as an introduction to a remunerative and responsible career. It is time that the real truth as to the position of the electrical graduate should be set forth, and that those contemplating entering the profession of electrical engineering should know at least a few of the difficulties that they will encounter.

Fifteen years ago the title of electrical engineer was rare; the men who could justly claim such a title were few, and the opportunities offered them by the then rapidly increasing development of the electrical field were practically without limit. In those days there were numerous manufacturing companies. The business of making electrical goods was divided among numerous concerns of moderate size, each employing designers, engineers and other functionaries to whom an education in electrical engineering was an essential. But there shortly began a movement toward the consolidation of smaller manufacturers, the absorption of little companies by big ones, and the formation, in the electrical field, of large corporations. Following the bent of the American character there came with this development a standardization of electrical apparatus, a simplification and unification of electrical design and the placing of the electrical manufacturing industry upon a purely manufacturing basis. There was no longer opportunity for individual design. Innumerable contracts were being filled with apparatus of approved character, of admirable construction and high efficiency; but there was not, as at the same time there was in England and elsewhere in Europe, any opportunity for an individual designer. The great manufacturing corporations had produced, under the stress of immediate demand and great necessity, incomparably fine types of electrical apparatus of almost every kind. The consulting engineer found that his practice was limited to the choice of standard types. To attempt an improvement upon one of these nvolved a large additional cost in manufacture and a delay in delivery.

The consequence of this movement, which in itself made for the prosperity of the electrical industry, and for the enlargement of the electrical field, was that the engineer, *per se*, found his field of action restricted. To an equal degree this was true of the electrical artisan and of the large field of endeavor that filled the intervening region between the constructing and consulting engineer and the man who oiled the dynamo. While in no other country in the world such a development of electrical engineering and electrical application has been seen, there has yet been in no other place so small an opportunity for the newcomer, or for the man not fully equipped with experience and knowledge of all varieties.

Ten years ago the graduate from an approved school of engineering who was able to show that he understood his business and was reasonably familiar with its practice could command a large salary. To-day the graduate from such a school is met with a situation similar to that of a young physician or a young lawyer. He finds the field occupied with many other and necessarily abler men, men with experience; and he must first gain what it is not possible to gain at a college—absolutely practical experience in using his hands and his brains in emergencies. He must work in a shop or in a factory or in a station. He must learn the commonest and hardest work by doing it; he must fit himself for the profession of electrical en-

gineer by doing first the work of the artisan, the constructor, the mechanic and even the laborer in his field. Notwithstanding this, our schools and colleges are turning out thousands of graduates annually, giving them engineering degrees and setting them adrift with a knowledge of the interesting and valuable literature of electricity, but few of them would be able to climb a pole or solder a joint.

To the young man, therefore, who feels an irresistible calling and predilection for electrical work it should be said that the road is a difficult one, that of the many who seek to enter the profession few are chosen.

It is not to be supposed that this is intended to dampen the ardor of any youth of real ability who wishes to enter the difficult field of electrical engineering. We need able engineers, but we do not need very many of them. As has been pointed out before in these pages, the urgent necessity at this time is for electrical artisans who know how to work with their hands. The conditions which surround the electrical manufacturing industry and those which circumscribe the members of the electrical engineering profession in the United States are such that the number of engineers who will ever be able to earn a living by the practice of their profession is small. The positions which it is possible for these men to occupy are, for the most part, filled. It may be said of them, as has often been said of other lucrative and desirable professions, that few die and none resign. Consequently, the impressions widely prevalent that electricity offers an unbounded future to the young man is fallacious. It does nothing of the sort. It offers to the young man who embraces it an opportunity to work very hard for a long time for small wages. It offers him about the same professional rewards as will be found in other and older avenues of effort. The statement that the art of electricity is in its infancy may have been true when those who read this were also in their infancy, but to-day this art has attained a sturdiness of growth that approaches maturity. Consequently, those who feel a calling toward electricity as a profession should ponder seriously the possibility of finding themselves, when they leave their schools of engineering, compelled to labor for awhile as linemen or wiremen, or, per chance, as dynamo tenders and oilers, and in this way to learn something that they may need in the future, and should not conceive the notion that they will at once proceed to design important apparatus or construct large stations, or be in charge of great works. It is to be hoped that no preaching of this character will impair the ardor of any youth who may feel elected to be an electrical engineer, but at the same time it is more to be hoped that no such youth will enter the difficult practice of this most difficult of all professions without having his eyes widely opened to what is before him, and without knowing that the road to success in electrical engineering is beset with innumerable pitfalls and, even for the most successful, with almost heart-breaking difficulty.

LARGE ARC-LIGHTING DYNAMOS.

In the paper by Mr. H. M. Biebel which appears on another page is an argument in favor of the large arc generator for central station work. With Mr. Biebel's argument only one fault can be found—that is that it hardly goes far enough. The largest units for arc lighting in general use absorb in the neighborhood of 100 horsepower each, and only a relatively small percentage of arc lights are burned from these large machines. In most places the time-honored custom of employing a large number of small units belted to a jackshaft, in a station which is a maze of belts and pulleys, is still followed. It is not alone the inefficiency of these little machines that disturbs the central station engineer, but also the great inefficiency of the belting and power transmission system employed with them and the large amount of valuable floor space occupied by such an installation. While it is true that the present 100-light and 125-light units are big enough for convenient direct-coupling to an engine, they are unfortunately constructed to run at rather high speeds. What is urgently desired is a large machine, absorbing say 500 horsepower or more and of a speed slow enough to permit its direct attachment to an efficient engine. If such a machine were built in the old-fashioned way, the terminal potential which it would give would be in the neighborhood of 30,000 volts, which is, of course, an utterly impossible pressure to handle on ordinary circuits. This increase in voltage with the number of lights burned in series has led to the introduction of several types of multi-circuit arc machines in which the potential is not higher than about 2,000 volts across any circuit. But the possibility of dividing the circuits by this method seems to have reached its commercial limit.

There is no problem more interesting and the solution of which would be more profitable than this presented by the peculiar status of the arc dynamo. There are to-day a good many methods for handling arc lighting from central stations, among them the old and satisfactory direct-current series system, the operation of enclosed lamps on constant potential mains, the use of similar lamps in series on an alternating circuit, and the use of rectifiers deriving their current from an alternating source of reasonably low periodicity. None of these possesses the simplicity and generally satisfactory character of the ancient series direct-current system. But this latter has the disadvantage referred to above of requiring in a large installation the use of many small machines. The problem is one well worth solving.

Where are the British volunteer electrical engineers? About three years ago this corps was heard of a good deal in the papers and seemed to be more or less fashionable. The lamented Dr. John Hopkinson was its commanding officer at the time of his tragic death. Most of its officers were then members of the engineering societies, while the rank and file was composed of electrical artisans. Drills were given in mine laying, cable cutting and repairing, boat and infantry tactics, and a variety of military evolutions. It was believed that this corps would prove itself of high value in war. So far, however, no news has come indicating its mobilization. To an observer at this distance this fact seems strange, because in South Africa there appears to be urgent need of the construction and maintenance of more and better systems of communication.

NORTHWESTERN ELECTRICAL ASSOCIATION.

THIS WEEK'S CONVENTION AT MILWAUKEE.

CHICAGO, January 15—The eighth annual convention of the Northwestern Electrical Association, which will be held at the Hotel Pfister, Milwaukee, Wis., on January 17 and 18, promises to be one of the best meetings in the history of the association. The attendance will probably be in excess of 150. About 25 members will go from Chicago, and the St. Louis contingent will go with them on a special train. A considerable number of manufacturers of apparatus and supplies have arranged for convention exhibits in their rooms at the hotel. Several of the prominent electrical supply houses will send three or four representatives each. Chairman James Wolff, of the committee on transportation and arrangements, expects a spirited meeting. The programme of papers to be read at the meeting is as follows:

"Modern Development in A. C. Series Arc Lamps," by R. Fleming, Lynn, Mass.; "Alternating-Current Phenomena," by Professor Jackson, Wisconsin University; "Combination of Electric Lighting and Hot-water Heating Plants," by W. H. Schott, Chicago, Ill.; "Central Station Economies," by H. W. Frund, Vincennes, Ind.; "Induction and Direct-Current Motors," by Ralph D. Mershon, New York, N. Y.; "Relative Desirability and Efficiency of Various Types of Engines on Central Station Loads," by Professor Richter, Wisconsin University; "A Life Test of Incandescent Lamps," by Professor Shepardson, Minnesota University; "A Canadian Plant," by L. G. VanNess, Quebec, Canada.

The present officers of the association are the following named gentlemen:

President, Henry L. Doherty, of Madison, Wis.; first vice-president, John H. Harding, of Laporte, Ind.; second vice-president, S. B. Livermore, of Winona, Minn.; secretary and Treasurer, Thomas R. Mercein, of Milwaukee; board of directors, Col. W. W. Bean, of St. Joseph, Mich.; J. H. Culver, of Decatur, Ill., and George Innes, of Eagle Grove, Iowa.

F. E. C.

Free Scientific Lectures in New York City.

An interesting and valuable series of lectures on scientific topics, designed especially for artisans, is being given in the Board of Education course of free lectures, at various school-houses and public halls in New York City. The programme of the course may be obtained by addressing Mr. Henry M. Leipzig, supervisor of lectures, 146 Grand street, New York city.

New York Rapid Transit Tunnel Bids.

The Board of Rapid Transit Commissioners, of New York city, received on January 15 two bids for the construction of an underground railroad. The bidders were Messrs. John B. McDonald, of Baltimore, whose bid for the whole work was $35,000,000, and Andrew Onderdonk, of New York city, who offered to build the road for $39,300,000. Both the bidders are contractors of prominence, and have constructed great works of various kinds.

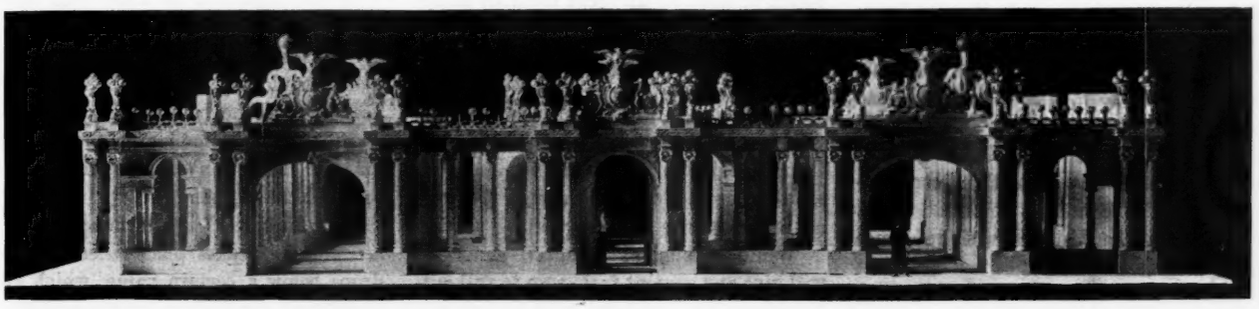
The commissioners decided, on January 16, to award the contract for the entire road to Mr. McDonald at his bid of $35,000,000. It is expected that the road will be running within three years.

Calcium Carbide.

The calcium carbide manufacture in Sweden is rapidly increasing. Not only is the Trollhottar factory, which for some time was the only one in Sweden, being extended, but new works have been erected at Alby, Mansbo and Brattfors, the first of which has already commenced operations. This will bring the annual production up from 1,000 to 6,000 tons. As the home consumption in Sweden was only about 100 tons last year, the bulk of the calcium carbide is intended for export, although, no doubt, the requirements of Sweden herself is likely to materially increase.

A Retrospective Exhibit at the Paris Exposition.

The handsome illustration that is shown herewith, represents the facade on the pavilion that is to be erected in the United States exhibit in the Palace of Machinery and Electricity, at the Paris Exposition of 1900. It is entitled "A Retrospective Exhibit of American Electrical Progress." The display of apparatus and models that will be included within its limits will show the wonderful progress made in this country since the beginning of the nineteenth century in electrical engineering. Among other things will be a number of Professor Joseph Henry's early experimental apparatus, the original telegraph instruments of Professor Morse, and other historical exhibits, showing the contributions of American electricians and engineers to electrical science. The handsome pavilion, which is about one hundred feet in width, is to be constructed of staff and ornamented with American spread-eagles and electrical lamps of large size. It will occupy a prominent position in the Palace of Electricity, and will doubtless be a gathering-place for American electrical engineers and others interested in the extraordinary development of electrical engineering in the United States.



PAVILION OF THE RETROSPECTIVE EXHIBIT OF AMERICAN ELECTRICAL PROGRESS AT THE PARIS EXPOSITION.

A consolidation of the Monongahela Street Railway Company, the Wilkinsburg & East Pittsburgh Street Railway Company and the East Pittsburgh & Wilmerding Street Railway Company is about to be effected, an agreement to this end having been reached by the directors of the several companies. The line will be operated under the name of the Monongahela Street Railway Company, and the capital stock will be $3,500,000. The officers will be: President, W. L. Mellon; vice-president, A. W. Mellon, and treasurer, R. B. Mellon. An agreement has been reached with the McKeesport, Wilmerding & Duquesne Street Railway Company by which cars will be run over that line into McKeesport. The total trackage will be 50 miles. About 100 new cars will be added.

THE DEVELOPMENT OF CONSTANT-CURRENT ARC LIGHTING.*

BY H. M. BIEBEL.

This paper will treat mainly of the generators used in direct constant-current arc lighting, but will touch upon several other points before considering the generator itself. The lamp has remained much the same as when first designed, of long and, in the majority of cases, of ungainly shape. Where the specific problem has been put before the lamp manufacturer of designing an ornamental shape of lamp he has succeeded in doing so, but in the majority of cases the design is anything but ornamental. When first designed the form was of little consequence so long as the lamp gave light; later the high voltages in use made the arc lamp undesirable for use in office buildings and the series type came to be used only outside, where its form was of little value so long as the lamp worked all right. In several instances at least the series arc lamp has profited by contact and comparison with the constant potential lamp, which had to be designed with reference to interior use and had to be made as short as practicable.

If a length efficiency of 65 per cent is reached, it can be considered a compact lamp. By "length efficiency" is meant the total length of carbon rods used, divided by the total overall length of the lamp. The more compact the lamp the better it looks.

To get the smallest lamp means to connect upper and lower carbon-holder by chains or bands wound on concentric drums, thus keeping the arc in the same position. A possible explanation of the standstill of several years' duration in constant-current arc lamp design may be this: That no sooner had the arc lamp been perfected than there sprang up many other forms of use for electrical energy, and the question of arc lamp design was allowed to rest.

When cable was purchased some years back, 3,000 to 5,000 volts was supposed to be the extreme of voltage to which we could go. It sometimes happens now that this same cable is used for higher voltages, say up to 8,250 volts. In this case, when two grounds develop, one on each side of the line and of sufficiently low resistance to cause a short circuit, it may happen that all but 20 or 30 out of 150 lamps are cut out of circuit, and no sooner cut out than thrown into circuit again by the burning out of the low resistance leakage path. This means that practically all the load is short-circuited and then thrown into circuit again The strain on the insulation when the load suddenly comes on again is hard to say the least.

Turning now to the generator itself we find this to have been the subject of a good deal of discussion, of greater interest and of much study. Statements have been made that if one takes a constant potential generator of poor design it will make a good constant-current generator. The facts in the case are that a constant-current generator can be designed by several different methods which differ only in details, exactly the same as with the different constant potential generators now on the market.

We have different conditions to satisfy from those in constant potential work, which we meet by different methods in designing the machine. The current is to remain practically constant under all conditions of load from the full capacity of the dynamo down to no terminal voltage, while the electro-motive force is to change from a high value to that necessary to send the normal current through the armature field coils and regulating device.

While a constant potential generator will give any current from zero to full output at constant potential, without any regulating devices whatever, it is a fact that but one commercial direct constant-current dynamo exists to-day which does not require a regulating device of some kind.

This brings us to the distinctive feature of the present arc dynamos, namely that the full voltage is generated at all times and used as required by the conditions on the line.

In a well-designed constant potential dynamo the brushes can not be moved around the commutator half the angular distance between brush studs, without excessive sparking. In a closed-coil arc machine this is done and with the following results: The brushes are placed nearly under the centre of the pole-piece when there is no load on the machine; they are moved backward as the load comes on, commutating the desired current sparklessly and varying the terminal voltage as required by the number of lamps on the line.

This means that at no load you are causing the current to flow in a reverse direction in about one-half of the armature coils, thus cutting down the voltage to a small value. As the load comes on the number of coils in which this reverse current is flowing is decreased and more and more coils are working in series to give the required voltage at the normal current.

The main point in arc dynamo design is so to proportion the various parts that the machine can run with the brushes under the pole-pieces, commutating the desired current sparklessly. Another feature to be looked out for is that the machine will not "flash over" easily when the load is suddenly increased. This is provided for by a correct proportioning of the armature and field strengths.

The value of a large change in current before flashing over will be apparent when it is seen that it means that the regulator need not act so quickly and that a greater number of lamps can be put in circuit at one time without affecting those already burning. This is of no importance on commercial circuits where flickering of the lamps is undesirable.

In contradiction to some who believe that an arc machine which flashes over easily, is to be preferred to one which does not, I would say that the less a machine flashes over, the better it is for all concerned—the line, the lamps, the commutator, the insulation on the armature, the belt and the engine.

"Flashing over" is a term applied to an action which takes place when a current drops below a certain value, which value is different for each machine and depends on the magnetic conditions present in the machine. A flash is carried partly around the commutator, starting from one or both brushes in bi-polar types, thus short-circuiting part of the coils and reducing the current still further, causing it to fluctuate violently for an instant. This fluctuation in current affects the voltage in proportion, thus changing the load on the generator, and at the same time causing the lamps to flicker for an instant.

Consider the formula for the calculation of the voltage in any dynamo: Electro-motive force $= \frac{N\,C\,n}{10 \times 60 \times a}$ where N is the total number of lines of force, C the number of conductors in series, n the speed in revolutions per minute, and a the number of bifurcations in the armature. With any given value of N we see that in order to make E large, we must make both c and n large and a small. This means that any given speed C will be large and if we make $a=1$ we will have a bi-polar armature with a large number of turns with fine wire.

A bi-polar armature gives us the maximum distance between brushes, which is a great consideration when 8,500 volts potential difference is generated between them.

By the use of a Gramme ring armature with a winding divided into a compara-

* A paper read before the Chicago Electrical Association.

tively large number of sections, we get the best arrangement as regards keeping apart coils having large differences of potential. We further reduce the difference of potential between the ends of any one section of armature winding, which means less insulation at any one point but more evenly distributed around between the different sections.

The question of smooth *versus* toothed core armatures is an interesting one, and a few considerations in regard to each will be appropriate. A toothed core armature protects the winding most effectually and allows of better ventilation between the armature plates. With a smooth core armature one does not get a very vicious flash where the machine flashes over. The current can be changed by a far greater amount than in a toothed core armature, the winding is much more secure and also more positively driven—two things, which when considered in the light of the strain on the wire and on the insulation in the slots and the change of direction of this strain at each revolution, become of some importance.

The matter of armature insulation is of the utmost importance where 8,250 volts are to be insulated against and the highest grade of insulating material and good workmanship are necessary. The best style of commutator is one with air insulation between the segments as, in that case, an accidental or occasional flash carried around the commutator will not do much harm. This style of commutator will also allow of using a fewer number of coils and higher volts per coil.

This means a simpler commutator and a lower cost of renewal when the commutator is worn out. An arc machine commutator will wear out much quicker than a constant potential machine commutator, by reason of the greater amount of sparking which takes place.

It is the privilege of an arc machine to spark and it does so and sometimes to an alarming extent. However, by reason of the small current used, the destructive effect will not approach that which would occur on a constant potential machine. A closed coil arc dynamo will have only minute sparks under or at the tip of the brushes when in proper condition, but it can be made to spark most viciously by neglect of wearing surfaces, or by incorrect position of brushes on the commutator.

In a constant potential generator the machine is never short circuited, while in an arc dynamo the circuit is never opened. In a constant potential generator, if one wishes to throw off the load he opens the circuit, while, in a constant current generator, he simply short circuits either that part he wishes to throw out of operation, or else short circuits everything, line and machine.

It has been only in the later types of arc machinery that the current has been constant from full load to no load. In the first type of arc machinery the current increased when the machine was short circuited and we find that, even to-day, a rheostat is used in connection with two types of machines to get a constant current.

There are two types of arc machines now on the market which do not shunt any current from the field circuit. One of these types produces a constant current by changing the width of space of brushes, increasing the span as the load comes on. The other type changes the position only of the brushes keeping the span constant. In this machine the various parts which go to make up the magnetic circuit have been so designed that this is sufficient. This means a simplification in the regulating mechanism, seeing that it does not involve making contact with any current-bearing part other than the commutator. It further means a reduction in the number of dangerous points around the machine and that the parts to be made and taken care of are reduced to a minimum. It also means, for that particular reason, a cheaper cost of construction.

It is not necessary to dilate here on the regulating mechanism, which is of simple mechanical and electrical construction, designed to move the brushes so that the terminal voltage shall be sufficient to send the normal current through the circuit. It should be of simple and strong construction, not likely to get out of order, quick to respond to any demands for increased or decreased voltage, and sensitive enough to bring the brushes to such a positon or positions that the current shall not vary more than one-tenth ampere from the normal value.

The limitation to increase of size of arc dynamos has been the high voltage, which has had to be taken care of and insulated against in the wires and appliances. The largest, single-circuit, 9.6-ampere arc dynamo built at the present time will deliver that current at a terminal potential difference of 8,250 volts.

The better general illumination gained by the use of 6 or 6.5-ampere enclosed arc lamps is leading to their use for outside lighting purposes, and should the problem of running 150 of these lamps from one machine, on a single circuit, come up it would be rather a formidable one. One hundred and fifty lamps, at 75 volts each, would require 11,250 volts, exclusive of line loss, which we may assume as 750 volts, so that we require a terminal potential difference of 12,000 volts. It is quite a serious proposition to insulate a machine and armature for this voltage, to say nothing of insulating the line and handling any lamp which is giving trouble while the line is alive.

To meet these conditions a new class of arc dynamos is being made use of, namely, the multi-circuit type. In this type of machine we have two, three, or more circuits which may or may not be inter-connected. These are so arranged that each circuit carries its share of the total lamp capacity of the dynamo, allowing the lamps on any circuit to be thrown into or out of the circuit without disturbing the lamps on the other circuits in any way. This gives a practical means for, first, cutting down the difference of potential between terminals; second, running large numbers of 6-ampere lamps from one generator, without too high a potential; third, increasing the size of units beyond the present figure.

In the days of the 40, 50, and 60-light unit, it was a frequent cause of complaint that one had to belt the machines and use a large number of them, owing to the small size of the individual unit. The capacity of the arc dynamo has been increased until we can now run 150 lamps, requiring 8,250 volts, at 9.6 amperes, from one machine. This means an input of a little over 110 horse-power, which would not be too small a unit for direct connection, were the speed low enough to make this feasible. Large, slower speed, multi-circuit units would readily admit of direct connection and require a large steam unit, while not increasing the maximum potential difference and therefore the danger of accidental shocks.

These larger units would be of use only in large city lighting plants, but there they would be of undoubted value. Direct connection means a saving of space and a higher efficiency, and if, in place of 12 belted units with a total capacity of 1,500 lamps, we could install six 300-light units, one of these being held in reserve, we should have a more efficient plant and one taking up less room. Of course as stated before, units of this size would only be accommodated where at last four could be installed; while for stations of smaller capacity, correspondingly smaller units would be used.

While larger single circuit arc dynamos could be designed and built, they could not be used on account of the great care necessary in insulating and handling the circuits.

The multi-circuit arc dynamo solves the problem of larger units with sufficiently low maximum potential difference. This type of arc dynamo will also give a solution of the problem of running 6-ampere lamps on commercial circuits.

While not advocating the use of direct-current arc dynamos in every case, regardless of existing conditions, it is well to consider the light output per watt input, and choose such type of lamp and such machines as will give the best distributed light for any given input.

The Telephone in Sweden.*

In no country, in Europe at least, has the telephone come into such universal use, or has become such an hourly necessity as in Sweden, and a short account of how this state of affairs has been brought about, and the present high degree of development been attained, may be useful and instructive reading to many. The principal reason for the rapid expansion of Sweden's telephones must, no doubt, be looked for in the amount of liberty which has been accorded them. Private and local initiative has done more for this quick development than the state would have been able to do in the first instance, while the manner in which the latter is now backing up the movement appears to be sound and practical. The state carefully felt its way and hesitated long before it took over any lines at all. In the year 1880 the International Bell Telephone Company took the first steps in connection with a telephone in Stockholm, and shortly afterwards small telephone installations were started by private enterprise in some provincial towns, these being the origin of the telephone unions. It is these unions which give a special feature to the history of the telephone in Sweden. In a few of the larger towns limited companies were formed, but as a rule the basis was a cooperative one. The members clubbed together to supply the necessary money for central station, etc., and although the telephones were bought jointly, each member paid for his own telephone and for the installation of it. These local telephone centres grew rapidly, and connection was established between those in the same province; thus cooperative sets of centres were formed nearly all over the country. They worked admirably together, and a member could, without any special fee, converse with anybody whose line was connected with his centre. The only limit to conversation was the technical difficulty of not being able to hear or to be heard. There were, however, as already mentioned, a few towns where the telephone was started by limited companies, as a commercial speculation. In Stockholm and Gothenburg it was the Bell Telephone Company, but this company had in both towns to compete with other telephone companies, of which the General Telephone Company, of Stockholm, has proved an unusually well-managed concern, extending its business to the neighborhood and other towns. An application from this company to erect telephone lines along high roads from Stockholm to other large towns was refused by the government, and this is the only instance where the government has placed any obstacle in the way of private telephone companies.

At the beginning of the nineties the annual fee for smaller concerns was 50 kr. ($13.85), and for companies with larger area, 90 kr. to 120 kr. ($25 to $33.35). The aggregate length of the telephone wires was then about 25,000 miles, and the number of subscribers 16,000. The state commenced its operations as regards the telephone in 1883 and 1884, when it acquired a few of the larger concerns in southern Sweden; but it was not till the telephone had attained to a much greater degree of perfection that the state began in earnest. It entered the field as an ordinary competitor, but has gradually bought the bulk of the telephone lines. The first long state telephone line (Stockholm-Gothenburg) was opened in 1889; its length was about 300 miles. Since then the state telephone has extended in all directions, the longest distance at the end of last year being Hoparndo-Ystod (1,250 miles).

The following table shows the growth of the Swedish state telephone:

Year.	Kilometres.	Stations.	Instruments.
1890	12,780	126	4,950
1891	22,760	235	10,250
1892	29,530	334	12,560
1893	39,230	414	15,970
1894	46,830	508	19,080
1895	55,620	559	22,740
1896	62,670	633	26,910
1897	75,300	734	32,890

As a rule, there is a cooperation between the state and the private subscribers, so that the former installs the connection to the nearest existing station, builds the new central exchange and finds the apparatus, while the subscribers' lines and the working of the central exchange are the latter's concern. There are exceptions to this rule; for instance, the large herring fishing district at Bohuslau. The rapid development of the state telephones —the subscribers to which have the right, subject to a modest fee, to converse all over the country—has, however, not prevented the private telephones from holding their own and partly expanding, as will appear from the following table:

Year.	Kilometres.	Stations.	Instruments.
1890	39,760	432	15,470
1891	37,840	392	14,740
1892	35,620	361	15,280
1893	36,650	404	16,640
1894	35,600	399	17,790
1895	38,650	391	19,590
1896	42,000	387	22,500

Several efforts have been made to bring about some uniformity in fees, both as regards state and private telephones; but the question is a difficult one, the more so as most private telephones have been sold to the state on the condition that the subscribers' fees shall not exceed 50 kr. ($13.85), and this is also about the average fee with the state telephone system. In some instances a state fee as low as 10 kr. has been fixed for a series of years; while in others, where the state had no competition from the start, fees of about 90 kr. ($25) are charged, which, however, after five years, are reduced to one-third.

Of the private telephone companies, the Stockholm General Telephone Company stands pre-eminent; its area of operation is now confined to Stockholm and a distance outside up to 45 miles, inside which there, however, are several smaller towns. Between the company and the state telephone there is a keen competition, which has brought about an almost ideal state of things from the subscribers' point of view. Fees have been reduced in some cases almost *ad absurdum*. The annual fee of the state concern is 50 kr., with an entrance fee, for business subscribers only, of another 50 kr. The length of line which the state erects for this price often exceeds two miles. The Stockholm General Electric Company has a scale of fees varying according to the requirements of the subscribers; this company has, in addition to its large and splendidly appointed central station, several auxiliary centres, while the state telephone has only one central exchange in Stockholm. The General Telephone Company charges from 50 kr. to 100 kr. for direct connection with the main exchange; for connection with the branch stations, the fee is 35 kr. (barely $10) annually, subject to a fee of 10 ore (two and two-thirds cents) for each conversation beyond the first hundred in each quarter, to which charge there, however, are so many exceptions that it has not much practical importance. An attempt has also been made with a minimum annual charge of 10 kr. and a charge for each conversation, but this has not worked satisfactorily. Competition between the state telephone and the General Telephone Company has also reduced the charge for longer lines, so much that the charge does not in many cases cover the actual outlay.

The result is that in Stockholm almost every small tradesman and artisan, and most fairly well positioned private people, have their telephone; there are now in Stockholm and the surrounding district upwards of 30,000 places where tele-

* From *Engineering*.

phonic conversation can be carried on. Many of the smaller users mean a direct loss to both concerns, for which the company recoups itself by a number of more remunerative subscribers, and the state by more lucrative business in other parts of the country and inter-urban conversations.

For conversations over inter-urban lines there is no extra annual fee, but a fee for each conversation, and these fees are, as a rule, uniform for private telephones and public stations. The fee is, for a distance not beyond 100 kilometres (62 miles), 15 ore (4 cents); for a distance up to 250 kilometres (155 miles), 30 ore (8 cents); up to 600 kilometres (335 miles), 50 ore (13 cents), and for longer distances, 1 kr. (26½ cents). These fees are for conversations of three minutes, one-third extra being charged for each extra minute. For express conversations, which are more and more used during business hours, the fee is three times the ordinary fee.

Their cheapness, more than anything else, has, no doubt, served to make the telephones such a popular institution in Sweden, and the cheapness has again resulted out of the manner in which the state has entered into the competition. Several circumstances tended to make it possible for the state to fix such low rates. In the first place, all small corporations, and some of the larger ones, find gratis premises for the state telegraphs; and, secondly, the telegraph clerks had so little work that they were able to take over the bulk of the telephone service without incurring any extra expenditure for the state. Besides, pay is generally rather low in Sweden, more especially for women, the female telephone clerks only receiving an average of 40 kr. (about $11) a month. The female telephone clerks are endeavoring to obtain an increase in their pay, and it, is of course, more than likely that the present low rates for telephone service in Sweden may have to be somewhat raised.

A Handsome New Type of Electromobile Dos-a-Dos.

A New Type of Electromobile.

The handsome electric dos-a-dos vehicle shown in the accompanying illustration is one of a number of automobiles recently constructed by Messrs. E. C. Stearns & Company, of Syracuse, N. Y., the well-known bicycle builders. This firm has undertaken to construct automobiles of the steam, gasoline and electric variety, and the vehicle illustrated is its first production in the electromobile line. The carriage has four wheels of the wire type and carries 44 cells of chloride accumulator. One motor of the company's own make is geared to the rear axle, the usual differential gear being included to allow the wheels to take different speeds when the machine rounds a corner.

The mechanism of the controller is unusually solid and substantial and is concealed under the front seat. In stopping the vehicle a backward pressure of the controller handle applies an exceedingly powerful strap brake to a drum on the armature shaft. In addition there is supplied an emergency brake operating upon the rear tires and worked by the operator's foot. This stroke is intended to be used only in cases of emergency or accident. The seating capacity of the vehicle is four persons and its capacity on one charge is about thirty miles on level streets. Charging requires about three hours, and speeds of about twelve miles per hour can be obtained. It has not been thought desirable by the builders to make the running speed of the vehicle more than this because of the danger incident to operating high-speed vehicles in streets. The vehicle is now at the repository of the Tinkham Company in New York city.

SUBSTITUTES FOR INDIA-RUBBER.*

BY H. L. TERRY.

"Among the uses to which the compound can be put, and for which it is eminently adapted, is that of the insulation of electric cables." This trite announcement, or something to the same effect, has appeared several times recently in circulars in which the claims of some new rubber substitute have been put forth, or in journals where the potentialities of the new body have come under discussion. It is certainly the case that at the present time an abnormal degree of inventive energy is being exhibited in order to find a body which may displace india-rubber in realms in which it has so long ruled supreme, and it may not be without interest therefore to discuss one or two points which should come prominently to the fore where it is sought to deliver judgment on these compounds. And in doing this I shall prefer to confine myself to generalities: it is not my intention to put any one of these substitutes upon the dissecting table, in order to point out to expectant students what may be disclosed by the scalpel of chemical analysis. The exact composition of the half-dozen or more newly advertised substitutes for india-rubber may or may not be easily disclosable by chemical means, but it is foreign to my present purpose to enter into such details here, or at any rate further than seems imperative in order to make my remarks comprehensible. I would further forestall possible criticism by at once disclaiming any attempt at continuity in the scraps which have been pieced together to form my subject matter.

Taking up my parable at deep-sea cables, a subject of enhanced interest at the present time in view of the proposed Pacific cable, it is important to note the two principal objections which have militated in the past against the employment of vulcanized rubber in place of gutta-percha. These objections are the porosity of rubber under pressure—or indeed at atmospheric pressure alone—and the fact that the coating of rubber has hitherto been put on the cable in a jointed condition, and not in the seamless state in which the gutta-percha covers the wires. These objections are of long standing, and have acted prominently in preventing the use of vulcanized rubber cables for deep-sea purposes, except in comparatively short lengths, such as, for instance, in the case of cross-channel cables and port to port cables on the coast line of a country. Now, it is extremely doubtful if the porosity in rubber can be overcome except by some drastic change in the methods of manufacture, but it is interesting to find that the erstwhile difficulty of putting the rubber on in a seamless condition has now apparently been overcome. According to the *India-rubber World*, of New York, some seamless india-rubber cables were made recently by the Safety Insulated Wire and Cable Company, the rubber coating being put on by special machinery in a seamless condition, the result up to date being in every way satisfactory. This being the case it presages an era of increased activity as regards the use of rubber insulation, and it may be predicted that to a great extent the two schools of thought, which have so long been in opposition on this matter of rubber for deep-sea work, will cease to be antagonistic.

Having thus referred to the main drawbacks of the rubber-covered cable, it is pertinent to inquire how far the new substitute for india-rubber can compare with the latter as regards these defects. The question is of course one for the buyers of the various bodies to find out practically, but, from what I have seen of one or two of these bodies, I am of opinion that they will be found less porous than is rubber, and that certainly in some cases there will be no difficulty at all in putting on the insulating mixture in the seamless condition. Other and weighty questions, of course, arise with regard to the insulating capacity and probable duration of life, the former of which can be answered without difficulty, although the latter must naturally in the case of new compounds remain for some time in the region of conjecture. On a recent occasion I referred in this journal to the inimical action which atmospheric oxygen and sunlight exerted upon india-rubber, and as these adverse influences do not make themselves felt in deep-sea cables, the conditions are altogether more favorable to longevity than obtain in respect to most rubber goods, and at any rate there seems no reason to predict such a limited life as has been the fate of so many electric light cables. It is strongly urged, from an American source, that the new Pacific cable might be made in America and insulated with rubber according to the process referred to above, though at the same time there are many people who, taking a dispassionate view of the matter, express much doubt as to whether the present resources of the states are equal to making and laying a cable of such magnitude without at least a certain amount of assistance from the old-established English firms in the same line of business. At any rate, if the project really comes to maturity, a heavy responsibility will lie on the shoulders of those who advocate the use of any but the best rubber insulation.

It may be true that, for certain purposes connected with electric lighting, excellent insulation has been obtained by the use of poor quality rubber. This view has been plausibly put forward by those who profess to have authoritative evidence, but I can not help feeling that the discredit which has come upon rubber insulation by the failures in some of our large towns is certainly to some extent attributable to the employment of low-class insulation from motives of economy. I was assured the other day, in Germany, that a first-class rubber cable will last a period of time much in excess of what has been experienced at many of our English installations; and my attention was particularly directed to St. Petersburg, where cables laid fourteen years ago were said to be still giving every satisfaction. That the multiplication of cable works, with resultant competition, has acted inimically on the rubber insulation business, was an opinion which my German informant sought to impress upon me; and I must say his words hardly needed the emphasis with which they were delivered to convince me of their truth, so permeated already was my mind with the same conviction.

I have not yet seen a substitute which compared at all to good india-rubber as regards the important attribute of tensile strength or elasticity, but of course this defect is not all-important, for there are cases where this quality is not particularly necessary, as, for instance, in door-mats. At the same time, I rather demur to the very catholic view which those persons who are interested in the sale of new substitutes take with regard to the applications of these bodies. Dust is often thrown in the eyes of the purchaser by the stress which is laid on comparatively unimportant points. Thus we are told that the new body is quite free from alkali, that it is quite unaffected by oil, and that it regards the onslaught of vitriol with contempt; but desirable though all this may be, it does not suffice to make up for lack of tensile strength. With regard to insulation, it is for the cable manufacturers to determine for themselves how far the results justify the confident tone of the circulars, though the best test—that of time—is one that is apt to prove rather trying to the inventor, who is eager to recoup himself for the outlay expended on experiment. It should be mentioned that the new substitutes are by no means mere

* From the London *Electrician*.

adaptations of our old friend oxidized oil, although this body is extremely prominent in more than one of them. Some, indeed, are so differently constituted to what has been before the rubber trade up to the present, that little or nothing can be asserted with regard to their behavior under varying conditions. Turning again to tensile strength, it is clear that this is not a prominent requisite in the case of insulating rubber, so it is quite possible that some of these substitutes may be found of considerable service. At any rate, there is this to be said for them: that, being already oxidized bodies, they can not, like india-rubber, undergo the chemical changes to which hydrocarbons are subject. In saying this I do not overlook the fact that a badly made oil substitute may undergo alteration resulting in the production of an oily mass, but the case hardly comes into the category of simple oxidation, which is so common with respect to vulcanized rubber. A point in favor of some of the new bodies is their freedom from sulphur, which means that there need be no fear of the corrosion of the copper, which is too commonly the case with vulcanized-rubber insulation.

Resinous bodies are less favorable to the diffusion of liquids and gases than is india-rubber, and it is no doubt owing to the fact that it contains so much resinous matter that gutta-percha is less porous to water than is india-rubber. Substitutes being more nearly allied to resins than to hydrocarbons, we may naturally expect that they will prove in this respect of equal if not superior value to gutta-percha, and *a fortiori* to india-rubber. In testing substitutes it should not be overlooked that their properties may undergo profound modification in admixture with rubber or with other substitutes. Thus the bodies made from rape oil, either by the action of chloride of sulphur in the cold or of flowers of sulphur at a high temperature, are practically insoluble in coal tar naphtha; at least it is impossible to make anything like a uniform varnish from them. In admixture with rubber, however, they can be made into perfect varnishes, as such are understood in the rubber trade—an important fact, which renders their application possible in many cases where failure to go into solution would prove fatal to their employment. There may be effects other than that of solution where the presence of rubber exerts a modifying influence, and so where tests of the properties of substitutes are being made it is important, if they are to be mixed with rubber in practice, to mix them with it in the experiments.

Chemical analysis does not afford all the information that we want, and it is absolutely necessary that such analysis should be supplemented by practical tests. Such practical tests must conform closely to the conditions likely to be experienced in the manufacture on the large scale. To give an instance where chemical analysis alone may prove faulty, it is well known that moisture in rubber mixing is to be strictly guarded against, as likely to cause air-holes during vulcanization. Yet in certain circumstances several per cent of water may be present without causing the least damage. I heard of a substitute recently being condemned by a chemist because it contained a certain amount of water, and though such condemnation was only to be expected on the facts of the case, yet it was really unjustified, because it was found in practice that very satisfactory results could be obtained by the use of the substance. In saying this I do not for a moment seek to show that the care which rubber manufacturers are in the habit of taking to ensure that their materials are perfectly dry is superfluous; I merely mention the point as an instance where generalization in such a complex manufacture as that of rubber goods may easily lead to false deductions.

ELECTROSTATIC ROTATION—IV.

BY ALFRED G. DELL.

The following are some additional experiments made with the slowly rotating disk mentioned in the ELECTRICAL REVIEW, of December 20, 1899. I find that when the disk is rotated by an induction coil, as described in the above-mentioned article, a change of the capacity of the condenser connected around the spark-gap of the primary of the coil has decided effects on the rotation. I stated, in the former article, that the disk rotated, but very slowly and poorly. I constructed a new apparatus, made in the same manner as the one described in former articles, but used great care in making it very sensitive to any impulsive force (the slightest air blown on one side will set it in rotation), and with this and plates with very sharp, raised points, I made the experiments described below.

To produce the force to drive the disk, I used a small coil and an adjustable condenser across the break-points of the primary of the coil (the original condenser that was in the base of the coil having been removed) with a dial arrangement so I could make rapid changes of the capacity. I found an addition of one-tenth microfarad reduced the velocity of rotation of the disk, and, as the capacity was increased, it reduced its velocity until it finally stopped, and when the condenser dial was turned back, reducing the capacity, it started up again; but when the capacity was below what was most favorable for the coil, the effect was also a reduction of rotation. By the most favorable capacity is meant that which will give the longest sparks between points. The experiment is meant that which will give the longest sparks between points. The experiment was very satisfactory when made, but troublesome at times to make on account of the feebleness of the forces from the small coil.

When I used a four-inch coil, making it give with a reduced battery only ¾-inch sparks, the disk always rotated, but there was a considerable number of fine sparks between the small plates, which interfered to some extent with the experiment.

I also stated that I let sparks pass between the points of the plates directly along the side of the disk close to it, but obtained no rotation. I repeated the experiment with the sensitive apparatus, and the reason I obtained no rotation before is now evident; the disk was not sensitive enough for such feeble forces.

The new disk rotated when the sparks were passing close up to it. While the tendency of rotation was generally from positive to negative, the disk, sometimes, would rotate in whatever direction started. If it was started in a certain direction, it rotated in that sense, unless I blew on it and started it in the other, when it then would rotate in that direction until interfered with by some force.

As an instance, using a ¾-inch spark, the disk started from the positive to the negative. After it had been running some little time, I quickly reversed the current in the primary and let it run for some minutes. It continued then from negative to positive without any apparent reduction of speed. I then blew on it, starting it from positive to negative again; it retained a constant rotation until I shut off the current, when it soon came to rest. On starting the current again, it started from negative to positive. I then doubled the primary battery, and found that there was a decided tendency to rotate from positive to negative, while, if started from negative to positive when the larger battery is used, it would rotate in that direction for some time, apparently receiving some force in that direction; but generally it would finally come to rest and start rotating in the opposite direction.

Mr. H. D. Latimer, who has for some time been connected with the Central Electric Company, of Chicago, in charge of its publication department, has resigned that position and assumed a similar connection with the Chicago Pneumatic Tool Company, of Chicago.

SCIENCE BREVITIES

Transmission of Hertz Waves Through Liquids—M. E. Branly, the inventor of the coherer, has been experimenting upon the above subject and, in a short paper before the French Academy of Sciences, gives his results as follows: The coherer was placed in the middle of a large glass recipient, containing the liquid to be tested, and was moved away from the source of waves until no effect could be noticed. It was found that distilled water and ordinary river water possessed a higher absorbing power for these waves than either oil or air. The effect of sea-water was notably large, and strata of this not more than about one foot thick, seemed to be sufficient completely to absorb Hertz radiation. Its absorbent power is greater than that of an equivalent layer of cement.

Harmonics of Rotary Currents—The greater the deviation of the curve of a rotary current *(drehstrom)* from the sine form, the more practically important it is to find which is the chief upper harmonic vibration and what is its amplitude with respect to the main current, says one of Mr. E. E. Fournier dAble's abstracts J. Zenneck, writing in *Weidemann's Annalen,* analyzes the current, considered as a four-phase current, by means of a Braun cathode ray tube acted upon by four coils symmetrically disposed, two of which are excited by one phase, while the other two are excited by a phase displaced 90 degrees with respect to it. Now, if the current is purely sinusoidal, the curve described by the spot on the fluorescent screen will be a circle. If "over-tones" are present, these will trace themselves on the circumference of the circle just as the original curve traced itself with respect to a straight line. It then only remains to count the number of maxima or minima of the radius. If there are four maxima, the secondary periodicity will be five times that of the main current, as one has to be added on account of the revolution. The ratio of the difference between maximum and minimum radius-vector to the radius of the circle indicates the ratio of the two amplitudes. In one case examined the relative periodicity was nine, and the amplitudes were as 1:36.

Electric Lighting of the Paris Exposition—The arrangements for the electric lighting of the Paris Exposition have just been made public. Along the Champs-Elysees there will be 174 direct-current arc lamps fed by underground conductors. At the Porte de la Concorde there will be twelve very large arc lamps; on the cupola and the minarets will be eight searchlight lamps, and sixteen simple reflector lamps upon the pylons. There will be in addition 3,116 incandescent lamps spread out over the monumental structures at this gate. The Alexander III Bridge will be lighted by 508 incandescent lamps in candelabra, each of the lamps being of 116 candle-power, and the whole fed by alternating current. On the Champ-de-Mars, the electricity building and the water palace will be lighted "as bright as day." The electricity building will justify its title by being lit with about 5,000 incandescent lamps, eight searchlights with colored lenses and four plain arc projectors. On the water palace there will be 1,098 incandescent lamps. The big meeting hall in the machinery building will be lit with 4,500 incandescent lamps. In the two palaces on the Esplanade des Invalides will be 2,136 incandescent lights with additional lamps in certain corners, bringing the round total up to 12,554 lights. These are simply the official lights. The total number will be much in excess of these figures on account of the lights in exhibitors' spaces.

Photographic Current Curves—The Braun vacuum tube possesses several great advantages over other contrivances for demonstrating the variation of an electric current, says an *Electrician* abstract. Operating as it does with a cathode beam deflected by a magnet excited by the current under investigation, it offers a weightless lever whose displacement is practically perfectly proportional to the current strength. Herren A. Wehnelt and B. Donath have improved the arrangement and made it available for quantitative determinations. They dispensed with the revolving mirror, as the images obtained with it were too feeble. Instead, they photographed the spot of light on the fluorescent screen on a sliding plate, and photographed, side by side with it, the sinusoidal curve of a vibrating tuning-fork, obtained by attaching a pin-hole in aluminum foil on the prong in the path of a strong beam of light. The curves reproduced are certainly very striking. Several of them show the course of the current from a Wehnelt interrupter under various conditions of capacity and inductance in the circuit. They all show the very rapid break, which practically obliterates that part of the curve altogether. One photograph shows the curves of current and electro-motive force, and their relative displacement, obtained with two independent lenses and two luminescent screens at right angles to each other. This method is closely analogous to that of Professor Angstrom for studying hysteresis curves, described in the ELECTRICAL REVIEW for January 3.

The Magnetic Qualities of Bricks—Messrs. O. A. Gage and H. E. Lawrence contribute to the *Physical Review* the results of their experiments on the magnetic qualities of building bricks. The authors selected 32 different qualities of bricks and ascertained their magnetic properties by means of an end-on magnetometer, constructed for the purpose. The centre of the brick is placed at a distance of about 6 inches from the magnetometer needle. The positions of the magnetic poles in the bricks were found approximately by presenting the different faces in turn to the magnetometer. The two opposite faces causing the greatest deflections were then considered to contain the magnetic poles. In all cases these were found to be either in the faces or edges and never in the ends of the bricks. The position of the poles was permanent, and could not be changed by any means at the authors' disposal. It was found, however, that the deflection varied with time. With the magnetometer used by the authors the magnetic moment of the bricks experimented with varied from zero up to 2.47, while 0.5 represents a fair average of the bricks displaying magnetic properties. Of course, the magnetic moment, by its determination in this way, and not being expressed in C.G.S. units, does not convey much to the mind, but it was found that the brick having the above mean moment was equivalent to a steel magnet 3.53 millimetres in length with .0325 C.G.S. unit to the cubic millimetre. The permeability of the bricks was found to be practically negligible. The authors consider, however, that the greater part of the magnetism is due to the presence of iron oxide in the bricks, as they found that the magnetic moment varied roughly with the quantity of this oxide in the clay. They explain the fact that the permanent magnetism is never found with its poles at the ends of the bricks, on the assumption that the magnetism is due to the cooling of the bricks in the magnetic field of the earth. The bricks when placed in the kilns are almost always either on an edge or a face, allowing the magnetic field of the earth to pass either through both faces or both edges.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE LXXXV—MERCURY CATHODES—THE FREE ELECTRON AND OTHER ETHER THEORIES OF CATHODE RAYS.

One of the most beautiful pieces of quantitative work on cathode rays is J. J. Thomson's determination of the charge on the particles. He found this to be 10^{-3} of that of the hydrogen atom in electrolysis, concluding in consequence that the cathode stream was made of hyper-atoms. Most of us would have been content with having reduced the idea of mass to such small units, but not so Sutherland. In the *Philosophical Magazine* for March he dismissed all idea of mass, saying that free electrons appeared in the ether, forming the cathode stream, the presence of ions being incidental only. He defined a free electron as a spherical shell of electricity. As stated in previous notes, I made cathodes of all the common metals, among others of mercury. After my attention had been called to Mr. Sutherland's theory I repeated one experiment with a mercury cathode. A tube was made as shown in Fig. 72 and attached to the pump in such a position as to leave both terminals, which were of platinum, uncovered as shown in B. It was exhausted until the X-light was brilliant. By bending the stem as indicated by the dotted lines the tube was brought into position B, the fluid metal covering the platinum cathode. The tube then had a mercury cathode. On exciting it again, the light, though bright, would not show the bones of the hand—because the waves were too long not to suffer diffusion in the tissues. Not being a physicist, theories were with me only considerations by the way while I was attempting to make a cheap and efficient X-light tube to be used in medicine. Therefore I do not criticise any of the ether theories of cathode rays, the experiment being mentioned hoping those who believe in these theories may explain why there was no X-light with a mercury cathode, for surely the ether is present in mercury as well as elsewhere; at least I have not yet made an experiment which disproves this. By bringing the tube back to the original position, the X-light flashed out again. The following explanation is suggested, as it appeared to be confirmed by work with a Rowland concave grating. A mercury cathode is not efficient because this metal does not contain enough hydrogen. The current is therefore carried by the metal, which on account of its weight does not strike the target with sufficient force to heat the particles to the high temperature required to make them radiant centres for X-light. When the platinum was uncovered again hydrogen came rushing out, producing the usual phenomena. When, on account of expense, a careful selection must be made from the wilderness of possible experiments suggesting themselves, it is always pleasant to have a simple and cheap experiment suggest in what direction future useful work may be done, for I do not love knowledge for its own sake, striving to know the mysteries, only that others may use them to diminish the suffering in this sad world of ours.

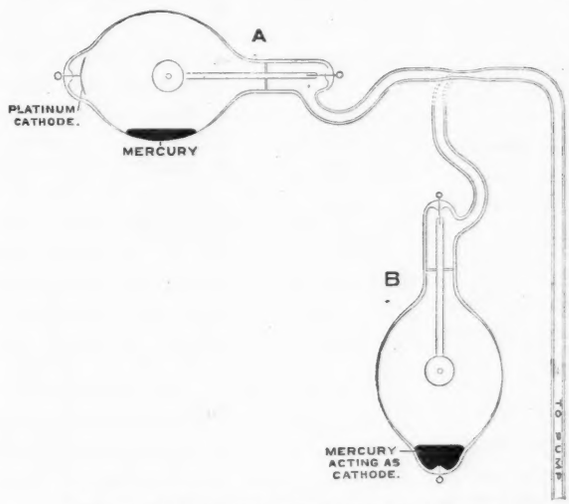


FIG. 72.- X-RAY TUBE WITH MERCURY CATHODE.

Aluminum.

Mr. J. H. Henderson recently read a paper before the Manchester (England) Society of Junior Engineers on aluminum as connected with electrical engineering. The paper in question was a good resume of the general subject of the properties of aluminum and the electrolytic methods of manufacturing the metal. Mr. Henderson called attention to the fact that while aluminum was widely diffused throughout nature, only during the last 10 years had it been produced in quantity; in fact, until electricity was used as a reducing agent the expense of the metal prohibited its commercial use. The following, says the London *Electrical Engineer*, is his description of the way the aluminum is produced electrolytically. One takes a metal carbon-lined crucible having two carbon electrodes, one of which acts as anode and the other as cathode. In it is put the following ingredients: fluoride of calcium, 234 parts by weight; double fluoride or cryolite, 421 parts; fluoride of aluminum, 845 parts. Three to four per cent of a suitable chloride—for example, calcium chloride—is then added. With this, sufficient alumina is put to form a very stiff mixture. Before electrolysis can begin, the ingredients are fused by means of heat, which should not exceed 1,210 degrees Fahrenheit. The heat is obtained from a furnace heated by gas, coke, or charcoal, care being taken that no gases from the furnace enter the crucible. When the mixture is fused, the electrodes are dipped into it, the current switched on, and the metal is gradually deposited at the rate of one pound of metal per five electrical horse-power hours. The current and pressure required varies from six to eight volts with one and one-half amperes per square inch. The metal from time to time is removed from the crucible by means of a siphon or a ladle, care being taken to remove as little of the haloid salts as possible. Another method of extraction, equally successful and more economical, was then described. In this other method similar ingredients are placed in a crucible having one or more vertically movable carbon electrodes, which are used as one or a collective anode respectively. The crucible, though lined principally with carbon, has some metal exposed to act as a cathode at the beginning of the process in order to generate heat enough to fuse the bath, after which the anode is placed so that the extracted aluminum acts as a cathode. The molten metal is from time to time run out of a tap hole into a mold and thence cast into ingots, or granulated by being poured into cold water. The same particulars as to results apply to this crucible furnace process also, only that not nearly so much of the bath is wasted in it, and the metal needs less purifying when molten. There is also no loss of time and money from the use of gas, coke, or charcoal, and of an extra furnace in this method. The author proceeds to deal with the use of aluminum as an electrical conductor, and points out that although the specific conductivity is not so good as that of copper, its low specific gravity enables it to compete with copper when the relative selling prices reach certain values.

It is rumored that the Board of Trustees of the Massachusetts Institute of Technology, Boston, will tender the presidency to ex-Governor Roger Wolcott.

ELECTRIC RAILWAYS

The annual meeting of the Pottsville, Pa., Traction Company elected all the directors. Thomas Prosser, of Philadelphia, was reelected president of the Tamaqua & Pottsville Electric Railway Company. R. C. Clymer was elected president of the Schuylkill Haven & Owingsburg Railway Company.

The Topeka City Railway has granted its motormen and conductors a raise of 20 per cent in wages. They have been paid 12½ cents per hour and the new order makes their pay 15 cents per hour, beginning January 1. The men are greatly elated over the increase because it has been many years since the system has been able to raise salaries.

The franchise of the Bucks County Railway Company, of Doylestown, Pa., will pass into the hands of the Union Traction Company on March 14, when, according to a decree of the court, the road will be sold. The sale is merely formal and is to give clear title, the stocks and bonds being already possessed by the Philadelphia concern.

The barns of South Chicago City Railway Company, at Holman and Sheffield Avenues, Hammond, Ind., were destroyed by fire on January 9, causing a loss of about $130,000. The barn, a brick structure, 75 by 225 feet, was destroyed, and 32 cars, including a number of motor cars, sweepers, sprinklers and a large quantity of apparatus were reduced to ashes.

The stockholders of the various street railway lines in Chester, Pa., met recently and elected officers. John A. Rigg was made president of the Chester Traction Company, the Union Traction Company, and the Chester & Delaware Street Railway Company. The Chester Street Railway Company elected J. Frank Black president, and the Chester & Media Electric Railway and the Chester, Darby & Philadelphia Railway companies, Richard Wetherill, president.

The immense principal power house of the Logansport, Rochester & Northern Traction Company's electric line will be located in Warsaw, Ind., and it is estimated that the building will cost $100,000. This company has just succeeded in floating bonds for construction and equipment to the extent of $2,500,000. Work on the line, which runs from Logansport to Kendallville, passing through Rochester, Warsaw and Albion, will soon commence. The portion of the line which connects Warsaw and Winona Lake, the Summer resort, will in all probability be ready for operation by June 1, this year. This new line will pass through a section of the state now difficult to reach by mail. It is 101 miles in length. Warsaw is located equidistant from each terminus.

The Electric Storage Battery Company has completed negotiations with the Brooklyn Rapid Transit Company for the installation of a large storage battery plant for use on the Brooklyn system. The railway proposes to begin the equipment of its system with storage batteries at once. It is also stated that the Storage Company has closed a contract with the New York, New Haven & Hartford Railroad for several plants, which will be used on the electric line of that road between Hartford and Berlin.

The annual stockholders' meeting of the Lykens & Williams Valley Electric Railway Company was held at Williamstown, Pa., recently with this result: Directors, H. A. Hoopes, C. C. Cocklin, Dr. John Oenslager, H. D. Hemler and W. E. Fletcher, Harrisburg. Subsequently the board organized with H. A. Hoopes as president; C. C. Cocklin, vice-president; M. G. Potts, treasurer, and John Oenslager, secretary. Messrs. Oenslager and Hemler succeed Messrs. Skiles, of Martinsburg, Pa., and Brown, of Derry, Pa., on the board. The reports of the operation of the road since its completion, a few months ago, were very encouraging. Cars are now running through to Lykens.

At the annual meeting of the stockholders of the Harrisburg & Mechanicsburg Railway Company, in Harrisburg, Pa., the following directors were elected: S. C. Gilbert, L. D. Gilbert, B. F. Meyers and W. L. Gorgas, of this city; M. C. Kennedy, Chambersburg; E. J. McCune, George H. Stewart, Shippensburg; George W. S. Cumbler, Highspire; J. J. Baughman, New Cumberland. Mr. Gilbert was reelected president and Mr. Gorgas, secretary and treasurer. The annual reports were highly encouraging, showing that 560,000 passengers had been carried over the People's bridge during 1899, an increase of 60,000 over the previous year. The electric company paid the bridge company $5,000 in tolls, or about two and one-half per cent on the stock of the bridge company.

A charter has been granted to the Pembroke, Mass., Street Railway Company, to operate a street railway from a point near the School street division of the towns of Pembroke and Hanson, through the towns of Pembroke and Kingston to a point near the terminus of the tracks of the Plymouth & Kingston Street Railway Company, in the town of Kingston. The length of the road will be about seven miles. The capital stock is $20,000. W. O. Chapman is clerk and E. J. B. Huntoon treasurer of the company, and the following are directors: John P. Morse, of Brockton; E. E. Hill, of Pembroke; W. O. Chapman, of Canton; Nathaniel Morton, of Pembroke; E. J. B. Huntoon, of Canton; L. H. Keith, of Kingston, and William W. Myrick, of Kingston.

The Hampton Roads Railway and Electric Company has been organized to build a new electric railway between Newport News, Hampton and Old Point Comfort, and to supply electric power and electric lights. The company has asked for a charter from the legislature and will be capitalized at not less than $50,000 nor more than $500,000. The chief corporators are W. J. Nelms, of Newport News, and Alvah H. Martin, of Norfolk. This company will operate in competition with the Newport News & Old Point Railway & Electric Company, which recently bought out James Darling's interests in the old electric line and also absorbed the Peninsula Railway Company, which started work on a rival line. The Newport News & Richmond Telephone and Telegraph Company, Robert P. Orr, this city, president, has organized to construct a telephone line between Hampton and the state capital. It will be the only line up the Virginia peninsula. Work will start as soon as the charter is granted.

S. L. Nelson, who has charge of the new street railway system of Wichita, Kas., has already bought 700 tons of rails, 300 tons of which is already shipped from Joliet, Ill. The other 400 tons are to be shipped from Pennsylvania at an early date. Two cars of spikes have been ordered for shipment January 10. Two cars of rail joints have been contracted for March 1, under a forfeit of $1,000 to be paid by the manufacturer if the stuff is not delivered on that date. Ten 16-foot vestibuled car bodies have been ordered for immediate delivery and trucks for shipment from Kingston, New York, January 22. Ten open cars have been ordered, four to be shipped March 20, two March 25, and four April 1, and two combination cars, 28 feet over all, to be shipped June 1. One boiler for the power house is to be shipped in 15 days, and engines are to be shipped 90 days from date of contract, December 23. New generators will be here some time the first of May. One hundred men will be put to work on the line February 15.

TELEPHONE AND TELEGRAPH

The Wolf River Telephone Company has completed the purchase of the lines and franchises of the Badger Telephone Company. The latter had about fifty miles of toll-line besides an exchange in Waupaca, Wis. The Badger line extended from Waupaca into Waushara County and will make an important feeder to the Wolf River system. The Waupaca exchange will be rebuilt immediately.

Arrangements are under way for building the new telephone line between Kineo, Me., and Northeast Carry. The poles are being got out, and if the frost is not too deep they will be set this Winter and the wiring done to be all ready for work by Spring. About 800 poles will be required. The line, when completed, will save many tedious canoe trips from the head of the lake, 20 miles, and from Chesencook Lake, a distance of over 40 miles.

A certificate of incorporation of the Farmers' and Merchants' Telephone and Telegraph Company, of Syracuse, N. Y., has just been filed with the Secretary of State. The company is organized for the purpose of operating throughout the state a telephone system in opposition to the Bell Company. Among the towns mentioned in its large list of places where it intends to do business are: Oneonta, Cooperstown, Binghamton, Walton, Unadilla, Norwich and most of the large towns in the interior of the state.

The Telephone and Telegraph Cable Company has not yet delivered a general assault on the Bell Telephone Company, but it is skirmishing round its outer works, and will soon be ready for business, says the *New York Commercial*. Under the management of T. H. Eckert, president of the Knickerbocker Telephone Company, the attacking forces are being marshaled, and business men and others now using Bell instruments will soon be called upon to make a change, which will be a pecuniary advantage to all parties, except, of course, the entity which its opponents lightly term the "octopus."

The wire mileage of the Erie telephone system was increased during the year as follows:

Long-distance poles set, 3,127 miles; long-distance wire strung (mostly copper), 25,552 miles. Total long-distance lines in service: Poles, 15,824 miles; wire, 71,691 miles. Underground wires placed, 19,650 miles. Total miles of wire in operation underground, 59,804. Aerial exchange lines built: Poles, 649 miles; wire, 24,878 miles. Grand total miles used for exchange purposes: Poles, 3,299 miles; wire, 124,658 miles. The grand total miles in operation: Pole lines, 19,123 miles; wire, 196,349 miles.

President John I. Sabin, of the Pacific states telephone companies, issues a circular to the effect that the Sunset Tele-

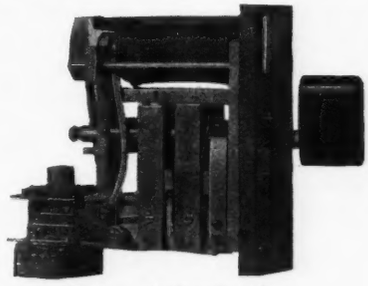


FIG. 1.—OPERATOR'S CAM.

phone and Telegraph Company, a Bell company, has purchased the property of the People's Telephone Company, of San Jose, Cal., an independent company. The original stockholders in the opposition telephone company in San Jose are stated to have lost every dollar they put into the business, the company having been sold out for debt, and the new stockholders who purchased the old company

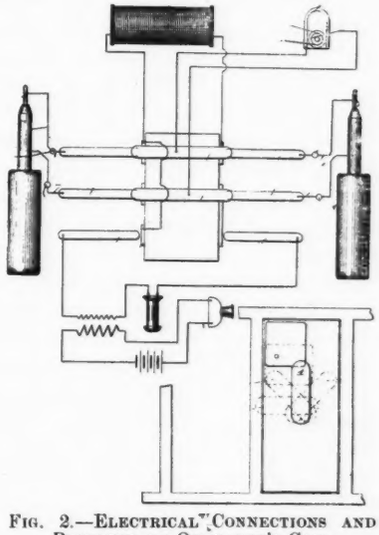


FIG. 2.—ELECTRICAL CONNECTIONS AND POSITIONS OF OPERATOR'S CAM.

for the amount of its outstanding indebtedness have now sold out to the Sunset Company for a sum less than that for which the property was knocked down under the hammer.

PHILADELPHIA, PA.—The stockholders of the Philadelphia Bell Telephone Company were allowed to subscribe at par for $10,000 additional shares. The option expired December 28. The stock is to be paid for in installments of 50 per cent January 10, and 50 per cent February 10. Certificates will be issued on the latter date.

An Improvement in Telephone Switchboards.

All who have operated telephone switchboards of more than medium size know the inherent difficulties connected with a proper operation of disconnection signals and clearing-out drops. The interesting invention shown in the figures herewith has been patented by Messrs. Seymour, Morrison and T. L. Springer, and is manufactured by the Eureka Electric Company, Chicago, and applied by them to their metallic express switchboard. The instrument is a combined, self-restoring, clearing-out drop, with an operator's cam. Fig. 1 shows this combination as applied to the switchboard, and Fig. 2 shows in diagram its method of operation. The upper part of Fig. 2 shows the various electrical connections, while the lower part exhibits the relative positions on the board of the drop and the cam and shows in dotted lines the four positions of the latter during operation. Counting around from the left, these correspond respectively to calling, talking, listening in—at which position the cam automatically restores the drop—and ringing the calling subscriber. It is stated that this apparatus has resulted in a considerable increase in speed in switchboards to which it has been applied, and that the disagreeable cross-talk noticeable in many other forms of disconnection signaling apparatus is obviated by its use.

The work of the operator is also facilitated by the fact that the cams always show by their position the condition of the lines.

A Question of Capacity.

TO THE EDITOR OF ELECTRICAL REVIEW:

Is not capacity and static capacity one and the same thing? Kindly answer this in your respected paper, and oblige a

READER.

New York, December 27, 1899.

[What is ordinarily spoken of as capacity in electrical work is the same thing as static or electrostatic capacity. It may best be defined as the amount of electricity necessary to charge a given body to one unit of potential. The capacity of anything varies with its surroundings. For example, a line of wire suspended on poles has very much less capacity than precisely the same wire when insulated and laid in a conduit. The unit of capacity is the farad, which is the capacity of a body such and so situated that one coulomb of electricity charges it to a potential of one volt. In practice this quantity is so large that the microfarad, or one-millionth of a farad, has come into general use as the practical unit of capacity—EDS.]

THE BRITISH ELECTRICAL SITUATION.

BY HOWARD B. LITTLE.

How much does the average man learn and forget in the course of a year? Such a question is really unanswerable, but we may arrive at some idea of the truth, so far as we ourselves are concerned, by reading one or two of the last January numbers of our favorite paper. As a result the most of us would be led to affirm that the question is far too wide.

It is with just this feeling that I set out endeavoring to give a brief *resume* of British electrical doings in 1899. Yet, though the past year has been a most eventful one, we can not claim that very much has actually been done. We have been thinking, learning, and in some notable instances, undoing. Further, it can not be till we are well used to writing 1901, or even 1902, that we shall become conscious of the benefit derived from this study and this destruction. Certain of our cherished institutions have been (justly enough) howled down, and others are being more than yapped at.

As a matter of fact we are passing through a transition stage here, and many things of the utmost importance to electricians are still in the balance. As we approach the twentieth century the two burning questions are: "Shall we get company-law reform? and is everything to be municipalized?"

Now, trying to be a true Prophet, I would answer these questions by looking back, and to read aright, it seems that I need only look at the events of the past year. To commence with, that august body yclept the Corporation of London, has found itself able to declare its contract with the City Light Company "null and void *in toto*." This, if one looks fact in the face, was because our company-law requires a vast deal of reforming. And the consequence of their being able to make such a declaration was far reaching. A monopoly (previously enjoyed by the City of London Electric Light Company), was cast to the four winds, or at least to some other companies. Now, following out the ramifications of this tortuous tale; while we know that it is always the way of consumers to grumble, yet it is very certain that city consumers had all been grumbling remarkably hard at the supply from the city mains, and they, as a body, jumped at the notion of a competing supply. Quite so. But so inconsistent are some people, that they raised a perfect howl of execration when it was suggested (or made apparent) to them that the roads would have to be reopened in order that these new mains to which they were so anxious for connection, might be laid. Here one sees immediately the short-sighted policy of some ten years back, and it is only necessary for me to write "Conduits."

At the present time one of our most wealthy vestries has just concluded an inquiry concerning the advisability of arranging such courses throughout its own area, at the same time endeavoring to bring about the co-operation of its neighbors. And the result? Just a blank. No one quite knows how the cost of reopening the streets should be met, or who would be the right persons to debit with the charges for putting in these conduits. In my humble opinion the "payers" should be those persons who will derive most benefit from the fact that the roads are to be taken up once in order to obviate the necessity of taking them up many times in the immediate future. But the conduit question is one to which reference must be made later, for its importance is by no means to be found only in connection with lighting mains. It may, however, be well to mention at once that every vestry, or body endowed with similar powers, is open to fight for all it is worth, in order that the streets may not be opened by or for anyone save itself. In some cases though they kindly offer to do this class of work for undertakers, usually at about one per cent profit. At times too this is a condition in the agreement when there is nothing for it but for the vestry to give its sanction.

Speaking of mains, what about the price of copper? There is a story current in the English papers to the effect that it is being inflated by a very powerful American ring, but, as new mines are being so constantly opened up, and as some of these mines are said to be capable of most remarkable outputs, the question arises (assuming the truth of the story), how long need we wait before we see the ring broken? Or must we wait until our sapient legislators make the use, or possession of a copper tea-kettle a flagrant breach of the law? In this connection one is tempted to think of the price of platinum, and of the wearing of platinum jewelry.

Yet, before passing from matters of supreme interest to electric light engineers, there are one or two other matters which stay our attention. In the first place we, as a nation, may congratulate ourselves upon the wonderfully expeditious manner in which Hereford has been "lit." The contracts were put out this year, and last week the station was running, everything reported right!"

Yet, one can not forget that it is only a few months since *experiments* were being made in St. Paul's Cathedral as to the possibility of introducing the electric light. This is the more annoying when one remembers how generous an offer was made to defray all costs.

Speaking of church lighting, some genius has unearthed an absurd law, by which it appears that ere the light may be installed in any church a "faculty" must be obtained from the Consistory Court, yet hundreds of churches have been so lighted though no one concerned had any faculty. They rubbed along just as well without it.

On alternating circuits, whether for power or light, it is easy to trace a marked tendency towards the reduction of frequency. It seems that in the former case, the general opinion is to the effect that 30 is sufficiently high, while for the latter purpose about 50 is "good enough."

Recently, too, nearly all our less wide-awake consumers have had their pressure doubled, that is, 100-volt circuits have been changed over to 200-volt. The companies have been very kind, doing all the work free of charge, and even giving "New lamps for old," while, as to the consumers, bless you, they don't know. Why should they? It's almost as good as putting the meter on the transformer primary!

But enough of light, it tends to fill all space. Among telegraphists nothing has been stirring of much import. This is at once their merit and their fault. We are so accustomed to a perfectly regular, uninterrupted inland service that it is high time they arranged a few interruptions, on their own behalf, that the public might begin to realize how perfect their arrangements usually are. But, and this is a big but, the burning question may be written "Pacific Cable." The ocean has taken it all very quietly so far, yet, it may soon be stirred to its uttermost depths. Details of all that has occurred would fill many ponderous tomes; further (and this is not Insular prejudice), I do not hesitate to affirm that the eyes of the world are on every move in this quaint game. Let me, however just remark *en passant* that while vested interests have a right to full representation, yet the needs of the Empire should come first. Also, alas, specious reasoning and deliberate untruth have been the two weapons used in this campaign. As to progress, an authoritative board has been formed. Authoritative in that it has full powers to make a report.

Now, as to telephones. The '99 Act has shattered the National Company's

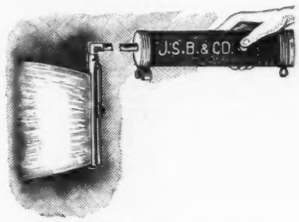
monopoly. And, when one looks back, one is compelled to this conclusion, that unfortunate company has been pilloried, deservedly perhaps, and an awful amount of mud has been thrown, some of which, unmerited, has stuck, while some, well, no matter. At present the position is this: Local authorities, and the post office, have the right to compete. But way-leaves are practically in the hands of the post office. And the conditions laid down by that body are very hard. They require the work done practically to their own specification, and it seems that in 1911 they will have the option of purchase on their own terms. Yet, this competitive telephone work is another reason which tends to agitation for lead conduits. "Pay, Pay, Pay."

So far, then, we see that change has been the order of the year here. And it will continue to be so for,at the very least, another year. We can not but admire that unconscious humor which suggested "Old Age Pensions," while the nation was suffering acutely from trades unions and their ways. As an instance of the kind of battle which has still to be fought here, note this! The majority of our coal miners have struck more than once (stating the case mildly) during the past two years, and at the end of each strike their wages have been raised. It is only a month or two since a large body of these men refused to work more than three days a week, because they thus earned sufficient to keep them for the entire week! (Would that I were one of them). Now, how pleased the tax-payers should be to provide them with every comfort in their declining years. One admires the miners' burly honesty. He declines with scorn the opportunity to become a bloated capitalist. Good man. What matters it to him if our navy be short of coal, or if our central stations are fined again and again because their smoke-stacks emit black smoke when they have to burn any coal they can get? He is above all these petty things, far above them, so let us pension him.

The so-called "labor clause," too, is one of immense difficulty. Broadly, the union says to any employer of labor "Our men shall not work for you unless, in every contract you put out you insist that the contractors shall pay union rates and observe union hours." The latter suggestion is if anything the more galling, because even if a good workman be anxious to do overtime, the union, the dread union, prevents him.

But let us look at a more cheerful aspect of our progress. Traction! Concerning traction we have been hugely laughed at, and we (or our legislators), have deserved it.

Yet it must not be forgotten that the "Light Locomotives on Highways" act only became law three years since, November 1896. And the law in this connection is something which should be given a very wide berth. But (though police prosecutions flourish), so also do several journals, and influential clubs devoted to the industry. The exhibitions which are held from time to time under the auspices of these institutions bring one fact out clearly; namely, that the percentage of electrically-driven vehicles is distinctly upon the increase. As to tramways, the provinces are going very strong. They continue to send *in*-expert deputations all over the world (at the expense of the rate-payers), to "make enquiries," yet they are stolidly putting down lines. In London alas! things are different, we have not got one tram-line there yet, apart of course from horse or cable traction. The trolley wire is objected to. It is not picturesque. Even in back streets where the washing hangs across the road, week in week out, the trolley is vetoed as ugly. Yet, London, from having been a gridiron is now becoming a cobweb on every plane below its surface. And next year its growth of subterranean electric railway will be still more wonderful. Finally, to report the progress which really has been made in 1899. Some monopolies squashed. Some company-mongers hooted, and some eyes a little bit wider open from a tour in Switzerland.



An Electrical Photographers' Flashlight.

This may seem the summing up of a rank pessimist, yet I would not be interpreted so, for I regard the outlook as one distinctly favorable. We have been thinking and learning, and we are in the throes (for the moment), of a state of violent transition. If we do not profit materially during the next two years, it is pretty certain that we shall in the third.

London, January 3, 1900.

Milwaukee, Wis.—The Waukegan Electric Light Company, of Milwaukee, Wis., has been incorporated. Capital, $60,000; licensed in Illinois for same amount.

An Electrical Photographers' Flashlight.

The little instrument shown in the accompanying illustration is a flashlight apparatus for the use of photographers. In the handle part of the instrument is a dry battery which communicates with a fuse upon which the flashlight powder is placed. The simple pressure of a button heats the electric fuse and ignites the powder. The whole apparatus is thus always ready for use, has no liquid contents to spill, and forms a most convenient accessory for photographic work. The cross-bar for holding the powder can be placed at any angle. One of the greatest advantages claimed for this apparatus is the possibility of holding it high above the head, giving a descending illumination which avoids the curious and sometimes ridiculous appearance frequently exhibited in flashlight portraits. It is stated by the manufacturers, Messrs. James S. Barron & Company, 24–30 Hudson street, New York, that one battery, with ordinary usage, will last about three months without renewal. The battery is inserted, like a cartridge, into the handle of the apparatus, making its connections automatically as it goes in.

Electrical Shipments to Australia.

Advices from Adelaide, Australia, to New York parties bring the information that a Mr. F. H. Snow has purchased the rights and plants of the Adelaide & Suburban Tramway Company for the sum of $1,067,500, and that extensive improvements will be made. As American manufacturers are advantageously competing in Australia in the requirements necessary for many undertakings, the above information may be of interest. Trade with Australia has kept up a steady growth during the last six months. The call from that colony for every kind of manufactured product during the period named is unprecedented. During the week ending December 26, the total shipments from this port reached nearly $400,000 to the British possessions in Australia. Among the largest shipments may be mentioned those of cement machinery valued at $15,000; mining machinery, $14,000; manufactured iron, $27,000; shoes, $10,600; leather, $35,000, and hardware, $17,373. It is claimed that in 1900 considerable mining machinery will be required in New South Wales on account of the increased production of coal and other minerals. England, it is also asserted, will not be able to cope with the demand in Australia for electrical machinery and apparatus, and the present time is none too early for American manufacturers to consider the appointment of agents in leading commercial centres able to furnish estimates. While in many lines of manufactured products the Americans are making fast headway in the Australian market, there are other lines which heretofore have been neglected, and these appear to be, according to well-informed merchants, machine tools, brass and iron fittings and many lines of electrical material.

Projected Cable to Iceland.

The projected telegraphic communication with Iceland is a question of interest to all northern Europe, says U. S. Consul Nelson, at Bergen, Norway. Especially will it be valuable in assisting meteorological observations, the various observatories thus being able to obtain daily telegrams concerning the state of weather in Iceland. It often happens that storms from the north sweep over Europe without previous atmospheric indications of their approach.

The main question at issue, however, is laying the cable. It will be 403.89 miles in length, extending between Iceland and the Shetlands. The Northern Telegraph Company of Copenhagen, Denmark, has offered to lay this cable under the following peculiar contract: The Icelanders shall pay to the company a yearly subsidy of $9,380 for twenty years; Denmark is also to pay a yearly subsidy of $13,400, and the neighboring countries are requested to contribute an aggregate sum of $91,450; thus, together, the interest included, an amount of $1,407,000 is desired by the company. Undoubtedly this business would yield a fair profit, as the usual price of laying a submarine cable is not higher than $1,200 a sea mile, and, according to this figure, the cost of laying the proposed line would not exceed $850,000.

Another telegraphic company has offered to lay the cable between Iceland and the Orkney Islands (a greater distance than the proposed line) for about $850,000, thus showing that the amount asked for by the Danish company exceeds by more than 50 per cent the expenses involved in laying the cable.

Not only, however, is the price asked exorbitant, but the manner of the payment itself is strange. The inhabitants of Iceland (72,000 or 73,000 peasants and fishermen), who for centuries have lived in no affluence, are asked to pay more than $187,600 for a cable for which they have almost no use, while it will bring other nations extraordinary advantage.

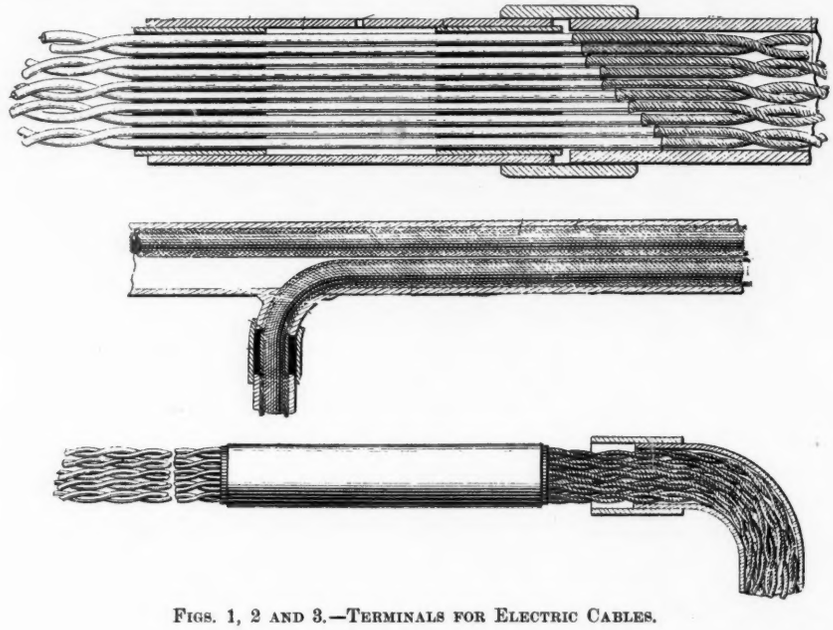
Apart from the already mentioned benefit to meteorology, the cable will also be of particular service to American, English, French, and Norwegian fishermen, who carry on their trade on a large scale in the neighborhood of Iceland.

A Delay in Mailing

A number of the subscribers of the ELECTRICAL REVIEW received their copies of January 3 two days later than was intended. This delay was caused by the failure of our envelope manufacturers to supply us as agreed.

Terminals for Electric Cables.

The increasing popularity of paper cables and of other forms of dry-insulation cables in which the insulating material is some fibrous or absorbant substance, such as cotton or paper, has resulted in attracting the attention of several inventors to the difficult problem presented by the terminals. It must be remembered that these cables, which are sheathed with lead or some other impervious metallic covering, lose their valuable qualities when moist air has access to their terminals, and the action of moisture in tending to creep by capillary attraction through the fibrous insulation material is greatly hastened by the constantly varying pressures of the air inside and outside of the cable. Three patents have recently been granted to Captain W. L. Candee, of New York, for termini which obviate this difficulty.



FIGS. 1, 2 AND 3.—TERMINALS FOR ELECTRIC CABLES.

Referring to the illustrations, which represent three types of cables, the general principle of the terminal arrangement is easily understood. The broad principle is that the assembled wires of the cable, or of each conductor in it, are united in a solid mass by casting around and among them a block of some easily melted metal, such as lead, and that at the point where this obstruction to the capillary action of the wires themselves is placed, a non-pervious and air-tight insulation of okonite, gutta-percha, india-rubber or some similar substance is placed.

The figures show several applications of the methods to jointings of several kinds. Fig. 1 shows a cable having several insulated conductors. Fig. 2 shows a cable having two conductors, one of which is branched off. The application of this terminal arrangement to a branching is very interesting. The usual lead pipe is employed, leading off—as shown in the drawing—and fastened to the sheath of the main cable by the ordinary solder-wiped joint. At a short distance from the joint the fibrous insulation is cut away for a few inches and the various wires of the cable to be brought out are firmly sweated together with tin or solder. This forms an air and moisture-proof junction in the body of the stranded cable itself. Upon the exterior of this section is placed the covering of impervious insulating material described above. This makes a tight joint with the internal surface of the branch-off lead pipe, the whole forming an effective bar to the entrance of moisture at any point. In Fig. 3 is shown the usual telephone cable containing many individual conductors. In these terminals the same result is attained by the employment of two blocks of the relatively hard and strong impermeable okonite, rubber or other insulation, surrounding the wires individually and collectively and making an air-tight joint with the inner surface of the cable sheath. Between these two dams of harder insulation the interior of the cable is filled with insulating material melting at low temperature, such as mineral wax or other impervious material, poured in while fluid.

These cable terminals are now being manufactured in large quantities by the Okonite Company, New York, and it is said that they are easily applied to cables of any description in the field.

Belted Types of Direct-Current Dynamos and Motors.

The practice of American builders of dynamo-electric machinery has resulted in effectively standardizing certain types of these machines, and introducing a very high grade of apparatus, calculated successfully to withstand all of the usual strains of practice. The illustrations shown herewith represent some types of such machines adapted for belt driving, and comprising a very modern and satisfactory design for such apparatus. It will be noticed that the curves of the base and other solid parts, while very simple and at the same time beautiful, are drawn upon well-calculated lines, and that the structure is essentially strong and rigid. These machines are designed for continuous—or nearly continuous—loads, and under these conditions of operation both efficiency and durability are factors of the highest importance. Along with these, freedom from undue heating and sparking is almost equally important. It is stated by their maker, the Crocker-Wheeler Company, New York, that between one-quarter of the normal load and an overload of 25 per cent, no brush adjustment is necessary, and that the operation of the machine is practically sparkless.

The specification under which these machines are built requires that after a run of five hours under full load, no part of the windings shall reach a temperature more than 40 degrees centigrade above the surrounding atmosphere. An overload of 25 per cent will increase this rise in temperature only about five degrees.

Fig. 1 shows the commutator end of a six-pole machine having compound windings, while Fig. 2 shows a smaller machine of similar type, having simple shunt windings. In Fig. 3 is shown in detail the rocker and brush rigging. The ring supporting the brush holders carries short adjustable arms on which the holders are mounted, and these are individually adjustable with reference to one another.

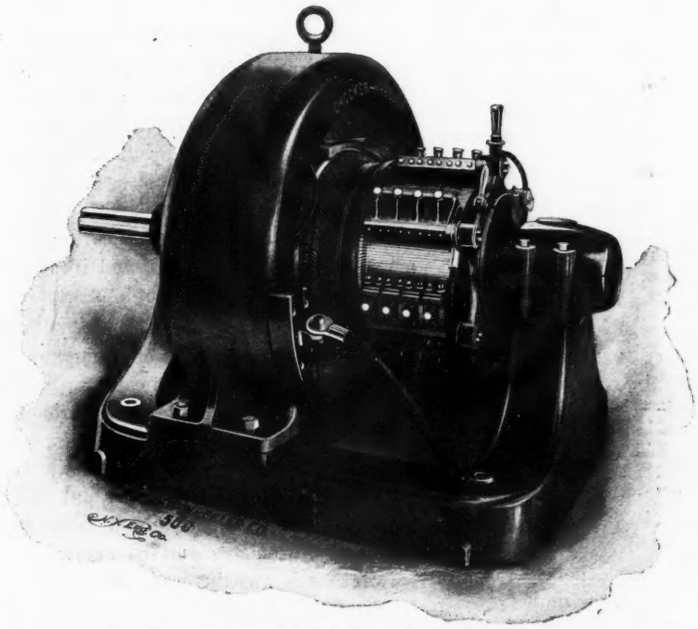


FIG. 1.—A SIX-POLE BELTED-TYPE DIRECT-CURRENT DYNAMO AND MOTOR.

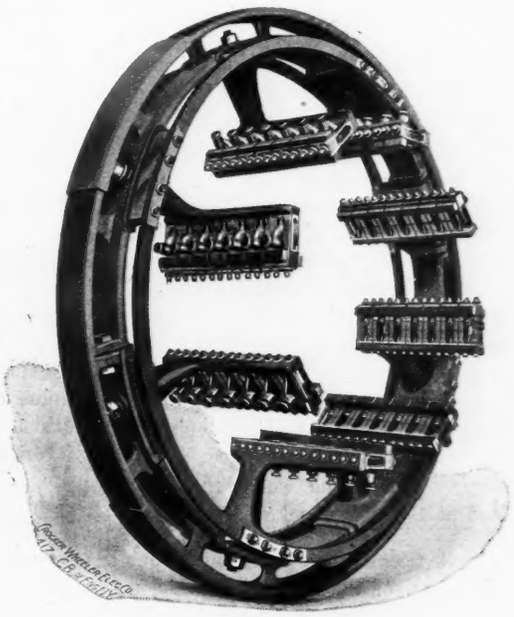


FIG. 3.—ROCKER AND BRUSH RIGGING.

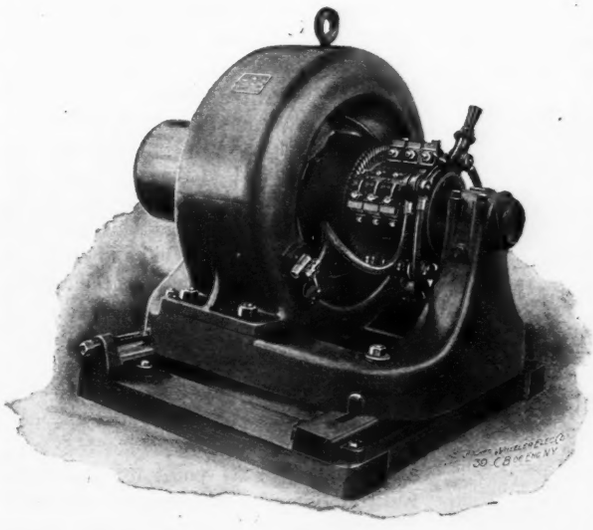


FIG. 2.—A FOUR-POLE SHUNT-WOUND DYNAMO OR MOTOR.

The whole ring is adjustable as a whole, turning in brackets bolted to the magnet frame as is well shown in Fig. 1. The brush holders are of very simple design, the carbon brushes being held in a composition metal box by means of a set screw, and this is fastened by a parallel motion spring to the back plate of the holder and is adjustable for tension by a thumb nut.

The great attention which has been paid to details of construction and to accurate standardization of parts has resulted in making these machines representative of the best engineering construction. The Crocker-Wheeler Company is to be congratulated upon the beauty and symmetry as well as the mechanical and electrical excellence of its recent output of machinery of this character.

Harbor works at Caotzacoalcos, Mexico, will, it is stated, involve an outlay of some $3,000,000. A very large share of this amount will be invested in machinery and apparatus for such work.

The Administrative Council, of the District of Ponta Delgada, capital of the island of St. Michaels, Azores, has been authorized by the Government of Portugal to invite tenders for the term of 90 days from the 12th of December last, for the laying and construction of a railway between Ponta Delgada and the Valley of Furnas and town of Ribeira Grande. Further particulars may be had by applying to the Consul-General of Portugal at New York.

VIEWS, NEWS AND INTERVIEWS

A newspaper in a Michigan town says of its local telephone service that it is something like the horse that had only two faults—the first that it was hard to catch when in the pasture, and the other that it was no good after it was caught

General Spaulding, Assistant Secretary of the Treasury, in charge of customs matters, in speaking of the action of the Merchants Exchange in Buffalo, in opposition to the assessment of a duty on electricity brought to the United States across the Niagara River, said that the Department had taken no action in the matter, as it had been brought to his attention only as a hypothetical question. The Merchants' Exchange had asked to be heard on the proposition and the request had been granted. If subject to any customs duty, in General Spaulding's opinion, it would be as an unenumerated, unmanufactured article, on which the duty is fixed at 10 per cent ad valorem.

G. R. Glenn, superintendent of public instruction of the state of Georgia, told this story to a Memphis newspaper man: One day he had explained the powers of the X-ray machine to a gathering of darkies who had assembled at a school commencement. After the meeting was over a negro called him aside and wanted to know if he was in earnest about the machine. Mr. Glenn assured him that he was.

"Boss, I wants ter ax you ef a nigger et chicken kin you look in him an' see chicken?"

"Why, yes, Ephriam," said Mr. Glenn.

"Well, boss, I want ter ax you one mo' question. Kin you look in dat nigger an' tell whar dat chicken cum frum?"

W. F. Beck, of Birmingham, Ala., wants $10,000 damages from the Western Union Telegraph Company for the results of the failure of the telegraph company to deliver a telegram. There was a young lady living in Centreville, Ala., who was so charming of mind and person as to capture the affection of several young men, W. F. Beck, among the number. She, however, was not certain which one of the half dozen of suitors she preferred. On the nineteenth of last June she made up her mind that any one of three of the men would make her a good husband, and she at once telegraphed to each of the three, telling him to come on and see her about the matter. Her intention seems to have been that the first who reached her should win the prize, but this is not shown in the pleadings. At any rate the three received the notices and responded promptly. W. F. Beck could not go in person, but he lost no time in telegraphing that he was hers to command. The telegram reached Centreville all right, but was not delivered to the young lady promptly. Meantime another of the suitors appeared on the scene and made good his claim to be the right man. The young lady accepted him and marriage followed. Beck wants $10,000 to assuage his injured feelings.

Wall Street and the Electrical Stock Market.

The week just closed in Wall street has been marked by a moderate volume of trading on the Stock Exchange and a distinctly reactionary tendency of prices. There was considerable liquidation in the industrials, in which there were obvious evidences of manipulation. Among the favorable incidents of the week were the progress of the Senate Currency bill, the easing of money rates throughout the world, and increased dividends on certain railroad shares. Toward the close of the week the greater ease in the monetary situation was a feature. The trade situation continues strong.

On the New York Stock Exchange General Electric closed the week at 123 bid and 123½ asked, a loss of ½ point for the week. Metropolitan Street Railway, of New York, closed at 165½ bid and 165¾ asked, a loss of 9¾ points for the week. Third Avenue Railroad, of New York, closed at 121⅝ bid and 123½ asked, a loss of 12½ points for the week. Brooklyn Rapid Transit closed at 68⅝ bid and 68⅞ asked, a loss of 3⅝ points for the week. Manhattan Railway, of New York, closed at 93⅞ bid and 94 asked, a loss of 1¼ points for the week.

On the Boston exchange American Bell Telephone closed at 332 bid and no asked price, a loss of 9 points in the bid price for the week. Erie Telephone closed at 104 bid and 105 asked, a loss of 2½ points for the week.

On the Philadelphia exchange Electric Storage Battery was not quoted. Union Traction closed at 38½ bid and 38¾ asked, a loss of ½ point for the week. Electric Company of America closed at 13¼ bid and 13½ asked, a gain of ¼ point for the week.

On the curb or outside market in New York Electric Vehicle closed at 55 bid and 60 asked, a loss of 10 points for the week. Electric Boat closed at 21 bid and 24 asked, a loss of 2 points for the week. Electric Axle closed at 5¼ bid and 5½ asked, showing no change for the week.

Wall Street, January 13, 1900.

ELECTRIC LIGHTING

A large force of men are at work at the Great Falls of the Potomac in Montgomery County, Md., completing the water-power plant to supply electricity to Washington.

The Waterford, Pa., Electric Light and Power plant, which was installed by W. R. Irwin a year ago last Summer and operated by him until burned out last August, has been purchased by Mr. Clinton Bolard. The plant has not been running since the fire, but has been refitted and it is expected that everything will be in shape to turn on both arc and incandescent lights within three or four weeks.

At a meeting of the Clear Lake, Iowa, Electric Light and Power Company it was decided to double the capacity of the plant. The power house will be rebuilt, a 150-horse-power boiler will be substituted for the 80-horse-power now in use, a 3,000-light dynamo will be put in in place of the old 1,000-light dynamo and other improvements will be made. The capital stock was increased from $10,000 to $20,000. J. L. Etzel is president of the company.

The electric lighting business of Kansas City, Mo., is in new hands. At the annual election of directors of the Edison Electric Light and Power Company and the Kansas City Electric Light Company, two companies passed into the control of Armours, of Kansas City and Chicago, Robert Fleming of London, C. F. Holmes and W. H. Holmes. The investment is over one million dollars. The principal owner of the two companies was the United Gas Improvement Association. It is out, as are the heaviest individual stockholders, Winthrop Smith and W. N. Coler, the Philadelphia and New York bankers.

The application of the United Electric Light Company, of Springfield, Mass., for permission to increase its capital stock $250,000, is said to be chiefly for the purpose of building a storage battery plant. The new storage battery plant will probably be built near the present plant at the foot of State street. The electricity will be generated at Indian Orchard, as is now done, and will be conducted from there to the new plant. The expense of a storage plant is large. The power from the engines will be transmitted direct to the dynamos without the use of shafting, and this will necessitate quite an expense, and with the increase in the old plant a new engine will probably be put in.

The Funeral of Mr. S. Dana Greene and Mrs. Greene.

The funeral of Lieutenant-Commander S. Dana Greene and his wife, whose sudden death by drowning was recorded in the ELECTRICAL REVIEW last week, took place at Schenectady, N. Y., on Thursday last. There was a large attendance of the friends of the deceased from Boston, Chicago, New York and Washington. A special train over the New York Central Railroad from New York, took quite a large party to Schenectady, Thursday forenoon, returning to New York city after the ceremony. A short service was held at the home of the deceased at 12.30 o'clock, and then the bodies were escorted to St. George's Episcopal church by Company E, Second Regiment, under command of Captain James Madison Andrews, and a detachment of the First Naval Battalion under the command of Lieutenant Andrews. All the members of the detachment served under Lieutenant-Commander Greene on the Yankee during the Spanish war. The services were conducted by the Rev. J. P. B. Pendleton, rector of the church, and by the Right Reverend William Croswell Doane, bishop of the diocese of Albany. Governor Roosevelt and his official staff were present, and among the pall-bearers were Mr. C. A. Coffin, president of the General Electric Company, of which Mr. Greene was a prominent official, and Captain J. W. Miller, of the Naval Militia. The different electrical associations to which Lieutenant Greene had belonged, were represented by committees, and among the officials of his company present, and others, were the following named gentlemen: C. A. Coffin, Eugene Griffin, J. P. Ord, E. W. Rice, Henry W. Darling, M. F. Westover, G. E. Emmons, A. L. Rohrer, J. R. Lovejoy, E. H. Mullin, F. P. Fish, C. T. Hughes, A. D. Page and J. W. Howell, Luther Stieringer, B. E. Sunny, Charles R. Huntley, W. S. Barstow, M. J. Insull, J. H. McGraw, Charles W. Price, T. C. Martin, Frank J. Sprague, E. H. Johnson, R. W. Pope, J. R. McKee, Edward S. Coward, S. M. Hamill and W. J. Hammer. After the service the funeral cortege was escorted to the New York Central station and was taken to Bristol, R. I., for interment. The business houses of Schenectady were closed during the funeral hours, and the entire city seemed to be in mourning for the death of two of its most highly esteemed citizens.

New Long-Distance Telephone Instruments.

The telephone transmitter and receiver, illustrated in the accompanying engravings, are intended especially for long-distance service or for use in independent exchanges where the highest quality of apparatus is desired. The transmitter consists of a granular carbon type instrument in which the granules are confined between ribbed surfaces of hard carbon. The diaphragm is made of heavy metal and is under tension from four auxiliary springs bearing upon its inner side. Mounted upon it, is a thin disk of carbon forming one of the surfaces of the cell in which the granular carbon is confined. The illustration shows the transmitter mounted upon an iron casting of neat pattern containing the ringer and induction coil. The receiver is of the bi-polar type. It is encased in a brass shell and supported near its poles so as to eliminate the effect of varying temperature. These instruments are covered by patents granted to Mr. Tiodolf Lidberg, who was formerly one of the chief engineers of the Ericsson factory at Stockholm, Sweden; they are now constructed by the Swedish-American Telephone Company, of Chicago.

NEW TYPES OF LONG-DISTANCE TELEPHONE TRANSMITTER AND RECEIVER.

New York Electrical Society's Meeting.

By courtesy of the New York & New Jersey Telephone Company the society will visit the company's main exchange, at 81 Willoughby street, Brooklyn, on Wednesday, January 17, at 8.30 P. M. Mr. F. O. Runyon, the engineer of the company, will deliver an address on "The Common Battery System," and describe the features of interest in the exchange.

The visitors will assemble on the fifth floor. After Mr. Runyon's address they will be escorted in groups over the building. The exchange is three blocks from the City Hall. Passengers on Fulton street or Myrtle avenue cars will get off at Lawrence street and walk one block to Willoughby street.

Wagner Electric Manufacturing Company.

The annual meeting of the Wagner Electric Manufacturing Company, of St. Louis, occurred on January 8. The old board of directors as well as the officers were reelected as follows:

S. M. Dodd, president; James Campbell, vice-president; S. B. Pike, secretary and general manager; W. A. Layman, treasurer and assistant general manager; Ferd Schwedtmann, general superintendent, and E. H. Abadie, manager sales department. Directors: S. M. Dodd, James Campbell, James W. Bell, J. C. Van Blarcom, S. B. Pike, Ferd Schwedtmann and H. A. Wagner.

The reports of the officers there represented showed an increase in the company's business during the year as compared with 1898 of 68.5 per cent. By vote of the board a dividend of eight per cent, payable March 10, was declared.

During the year there have been many rumors current to the effect that the majority of the stock holdings of the Wagner Company had been disposed of to some of its eastern competitors, and that the business was now fully under the control of these competitors. All these rumors have been absolutely without foundation. The stock is held entirely by St. Louis parties, and the officers and directors of the company are all representative St. Louis business men. The year just closed has been one of the most successful in the history of the company, being specially marked by a large number of important contracts calling for a high grade of engineering work.

The annual meeting of the stockholders of the Tiffin (Ohio), Fostoria & Eastern Electric Railway Company was held a few days ago, and the following gentlemen were elected directors for the ensuing year: W. H. Gabriel, D. H. Kimberley, Charles O. Evarts, C. W. Gabriel, S. B. Sneath and B. G. Tremaine. The directors then elected the following officers: D. H. Kimberley, president; W. H. Gabriel, vice-president; Charles O. Evarts, secretary and general manager; S. B. Sneath, of Tiffin, treasurer.

The Manufacture of Carborundum.

The new abrasive substance, carborundum, is one of several interesting and unexpected products of electrical application. It is a crystalline substance of great beauty, resembling amethyst in color, and is almost as hard as the diamond, being separated from it in the scale of hardness by a practically inappreciable amount.

The first furnace for making carborundum consisted of an iron bowl lined with carbon and a carbon rod. In the bowl was placed a mixture of clay and coke dust, and the rod was thrust into this. When a current sufficiently great to fuse the mixture, or, at least, to bring it to a state of blazing incandescence, was passed through, and after the furnace had cooled down, a few brilliant blue crystals were found around the carbon rod.

In the earlier forms of the commercial furnaces, it was attempted to produce an arc in them and to use the high temperature thus created to work the necessary chemical changes. This method, however, was abandoned in favor of an incandescent furnace in which a core of granulated coke is heated by the passage of the current to an enormous temperature, which can be regulated with great ease by regulating the current.

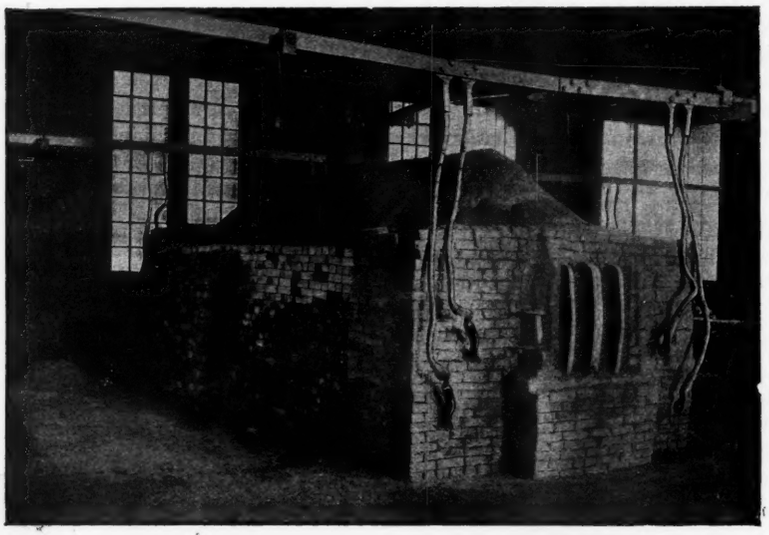


FIG. 1.—A CARBORUNDUM FURNACE READY TO BURN.

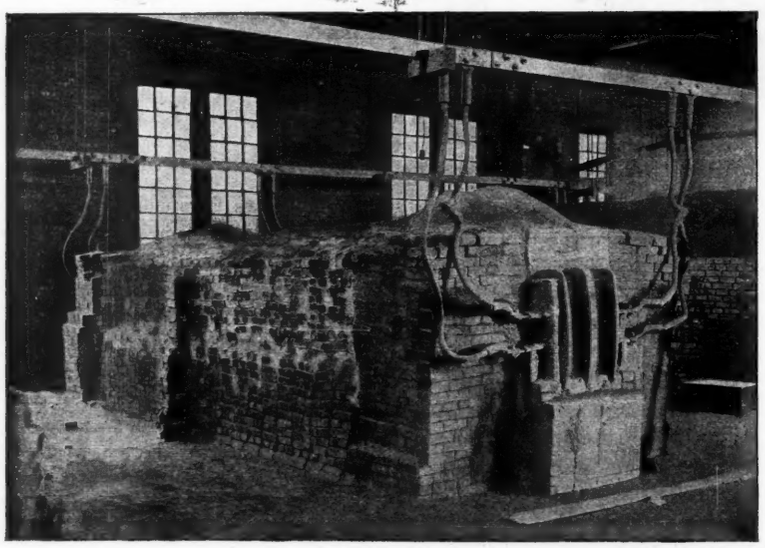


FIG. 2.—A CARBORUNDUM FURNACE BURNING.

At the Niagara Falls works of the Carborundum Company, scenes in which are illustrated by the engravings herewith, the crude materials are received in the form of coke, sand, sawdust and salt. These look like a somewhat peculiar set of components for the jewel-like crystals which are made from them. In fact, the essential ingredients are the coke and the sand, because carborundum is carbide of silicon, or silicide of carbon—either way one pleases to name it—and is composed of these two elements in chemical combination.

The materials referred to above are all ready for using when they arrive at the works, with the exception of the coke. This has to be ground to granules of a certain size for use in making the cores in the furnaces and to a fine powder for use in mixing the charge for the furnaces. The grinder breaks it up, and the coke is screened by cylindrical screens to the proper size for these purposes. The dust falls into a bin near which are scales on which the sand, coke, sawdust and salt are weighed out in proper proportions and sent to a mechanical mixer. The mixture prepared by this machine is kept stored in a bin ready for use.

It may be mentioned here that the salt and sawdust are purely incidental to the process; the former is used as a flux to facilitate the running and melting of the mixture, while the latter by burning away leaves the mass in the furnace in a highly porous condition, allowing the escape of gases without dangerous explosions.

The furnace room contains five furnaces but has a capacity for ten. These are oblong brick boxes about 16 feet long by 5

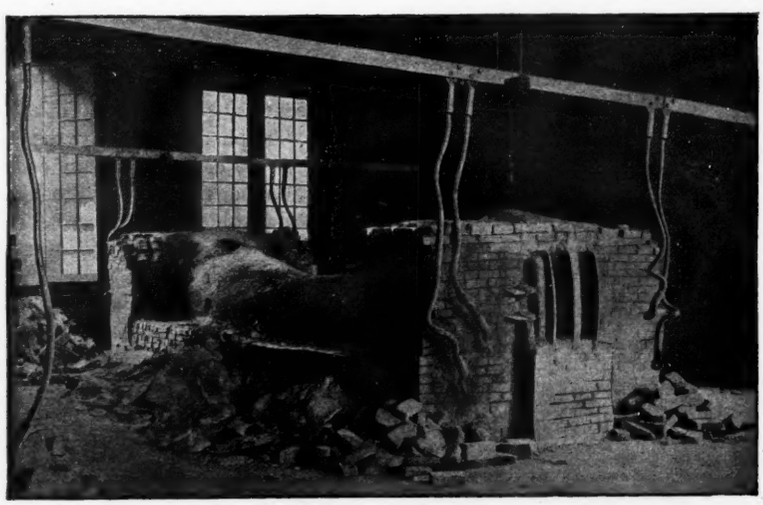


FIG. 3.—CARBORUNDUM FURNACE DISMANTLED AFTER BURNING, SHOWING CORE OF CARBORUNDUM, PERMANENT END WALLS, ELECTRODE PLATES, CONDUCTORS, ETC.

feet wide and 5 feet deep. The ends are built up very solidly with a thickness of about two feet of bricks. At each end, in the centre of these walls, is a terminal consisting of 60 three-inch carbon rods about 30 inches long. These end outside the wall in an elaborate metallic terminal plate to which are bolted the great cables conveying the current from the sec-

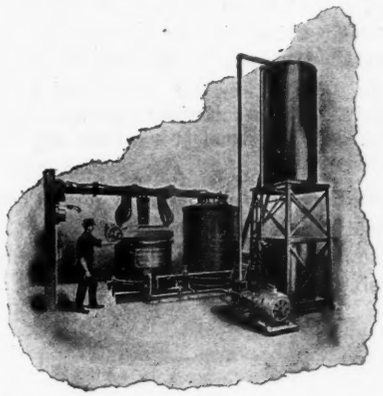


FIG. 4.—CARBORUNDUM MAKING—THE GREAT TRANSFORMER.

ondaries of the large transformers described below. These terminals, connections and the general appearance of the furnace are well illustrated in Figs. 1, 2 and 3. The brick ends of the furnace are its only permanent parts, the rest of it being dismantled and rebuilt with each charge, as is shown in Fig. 3.

The side walls of the furnace are first built up to a height of about four feet. Pieces of sheet-iron are then placed at a small distance from the inner ends of the carbon rod terminals in order to keep the mixture from coming in contact with them, and the furnace is filled rather more than half full with the mixture. A semi-circular trench, having a radius of about 10½ inches, is now scooped out of the mixture from end to end of the furnace, and into this is introduced the core which has

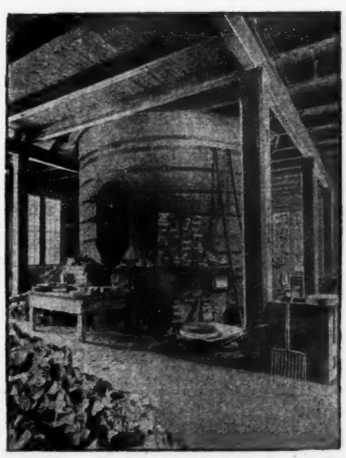


FIG. 8.—CARBORUNDUM MAKING—A SECTION OF THE KILN ROOM.

been carefully weighed so that the exact amount of material required is used. About 1,100 pounds of new material, or about 850 pounds of core material that has been previously used, are required in the furnace. All of the core material having been emptied into the trench, its top is neatly rounded over, leaving a cylindrical body about 21 inches in diameter and 14 feet long, composed of small fragments of coke and extending nearly to the electrodes at each end of the furnace. The connection between the core and the carbon terminal is made by packing finely ground coke behind the sheet-iron pieces mentioned above, which are then removed. The crude material is heaped on top of the core, as shown in Fig. 1, and the furnace is then ready for burning.

Alternating current at the frequency of the Niagara plant—25 cycles per sec-

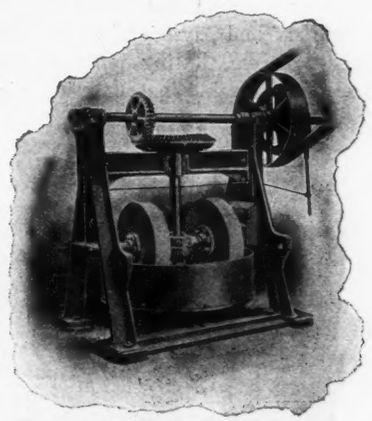


FIG. 5.—CARBORUNDUM MAKING—THE GRINDER.

ond—is used, at a pressure of 185 volts. A very large transformer, having a capacity of 830 kilowatts, reduces the current from the pressure of 2,200 volts, at which it is delivered, to the required voltage.

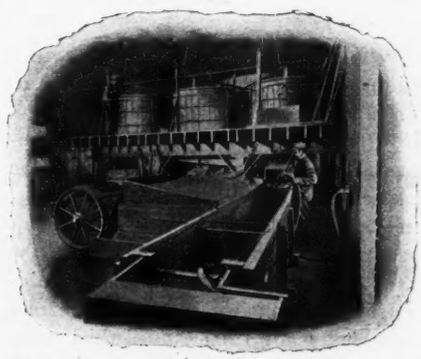


FIG. 7.—CARBORUNDUM MAKING—TREATING THE PRODUCT CHEMICALLY.

In circuit with this is a regulator, giving a range of from 100 to 250 volts to the secondary current. The transformer is cooled by oil circulation, the oil being cooled in one of its tanks by a coil of water pipe. A small motor keeps the oil circulating through the tanks and transformer. The main conductors entering the furnace room have a sectional area of no less than eight square inches each. They are well shown in the illustrations, which also show the leading cables to the terminals. The circuit to the furnace room is closed through a water rheostat, which consists of a large circular iron tank containing salt water and in which a plate may be lowered until it rests on the bottom. To break the circuit, this is hoisted up and the circuit broken at the surface of the liquid, with, of course, a tremendous rumbling and flashing and a cloud of steam. This, however, is a safer method of interrupting the circuit than handling the high tension primary or attempting to use ordinary switches.

At first, as the core warms up, the volume of current taken is relatively small, especially if new core material has been used. With old material, the resistance appears to be lower, the impurities having been driven off, and the furnace using this takes about 1,200 amperes at the start. At the end of about an hour, by manipulating the regulator, the energy consumed in the furnace is brought up to about 1,000 horse-power. At this figure it is kept by reducing the voltage as the mass heats and its resistance falls.

After the circuit has been closed in the transformer room no apparent change takes place in the furnace for about half an hour. Then a peculiar odor is perceived, due to escaping gases, and these may be ignited with a match, the ignition often being slightly explosive.

When the current has been on for three or four hours, the side walls and top of

FIG. 6.—CARBORUNDUM MAKING—THE 1,500-TON HYDRAULIC PRESS.

the furnace are completely enveloped by the lambent blue flame of carbon monoxide gas, formed by the combination of the carbon of the coke with the oxygen of the sand. During the run of a single furnace five and one-half tons of this gas are given off. At the end of four or five hours the top of the furnace begins to subside gradually, fissures form along the surface, from which pour out the yellow vapors of sodium. Occasionally, the mixture on the top of the furnace is not sufficiently porous to allow the rapid escape of the gases. The result is that the latter accumulate until the pressure is so great that, at some weak point in the mixture above, a path is forced open and the gases rush out violently. This is termed "blowing" by the workmen, and the phenomena accompanying it are frequently as follows: A fissure suddenly forms at some point in the top of the furnace, and from this burning gases rush out with a loud, roar-

ing sound. A miniature crater rapidly forms from which white-hot cinders are thrown to a height of several feet, the issuing gases meanwhile burning with a dazzling yellow flame, dense white vapors soon filling the whole furnace room. In a bad case of this kind it is necessary to cut off the current from the furnaces and allow the latter to cool down somewhat. Then the mixture surrounding the crater is dug out to a depth of about two feet, exposing the "blow hole," which is removed, and the cavity formed filled up with fresh mixture. It is mainly for the purpose of avoiding this "blowing" that the sawdust is put in the mixture, since the former, by making the mixture porous, allows the gases to escape freely.

At the end of about 24 hours the current is cut off from the furnace and it is allowed to cool for a few hours. Then the side walls are taken down and the unchanged mixture raked off the top of the furnace, until the outer crust of amorphous carborundum is reached. This crust is cut through with large steel bars, and can then be easily removed from the inner crust of amorphous carborundum. The inner crust is next removed with a spade and the crystalline carborundum exposed.

A cross section of a carborundum furnace presents an interesting and beautiful appearance. In the centre is the core, which, on examination, is found to be very different in some of its physical characteristics from the coke of which it was originally composed. It no longer possesses a bright metallic appearance. Many of the kernels are quite soft, and can be squeezed between the fingers, leaving on them a mark like black lead. In fact, the high temperature to which the core has been raised has driven off all impurities from the coke, leaving nothing but pure carbon, either in the amorphous or graphitic form. From the core radiate beautifully-colored carborundum crystals to a distance of 10 or 12 inches. A single furnace yields over 4,000 pounds of crystalline carborundum. Most of these crystals are not remarkable as regards their size, but in places, where hollows have formed, large hexagonal crystals are found, sometimes measuring one-half inch on a side. At the distance of 10 or 12 inches from the core the crystals suddenly cease, and, instead, we find a thin layer of a light-green color, which is the inner crust of amorphous carborundum. Beyond this is the outer crust of amorphous carborundum, and this also ends abruptly in unchanged mixture. Other curious substances are sometimes produced in the furnaces; for example, silica, which has the appearance of spun glass.

The New Paltz & Poughkeepsie, N. Y., Traction Company has been incorporated, with a capital of $100,000, to operate a street surface railroad nine miles long, from the Poughkeepsie ferry at Highland, Ulster County, on the New Paltz turnpike, to New Paltz. The principal office of the company will be in New York city.

A Novel Type of Primary Battery.

For many years there has been an effort on the part of electrical engineers to devise a primary battery that will be useful commercially, and, while occupying small space, give such an output of energy as will make it available for lighting and power purposes. The battery illustrated herewith is claimed to be capable of filling the requirements of such a generator of electricity, and has already been applied in many situations where primary batteries are useful. Among various uses that it has already found may be mentioned those for sewing machine motors, electroplating, dentists' and physicians' offices, telephony, signaling, testing purposes, etc. Concerning its value in connection with

Two Forms of a New Type of Primary Battery.

mining lamps, Professor Sylvanus P. Thompson said that, a short time ago, he with many other gentlemen, was engaged on the Woolwich Commission in the inspection of 200 different miners' lamps, and that when the test of blowing them up was tried, not a single one would stand the test. He adds that there are 100,000 miners injured every year—not all by explosions, but many from causes which arise entirely from deficient light. In the Edison, Jr., electric miners' lamp the light was thrown upwards as well as sideways, and even if it were true, which it is not, that it costs more than the ordinary safety lamp, he thought it ought to run the ordinary safety lamp out of existence.

The officers and directors of the company which manufactures this battery, the Edison, Jr., Electric Light and Power Company, are as follows: C. T. Thayer, president; H. W. Fuller, vice-president; H. C. Hepburn, treasurer; Hon. John Rice, Hon. Patrick Egan, E. A. Drake, E. R. Lazarus, and A. G. Montgomery.

EXPORT NOTES

One of the largest of the recent contracts undertaken by the General Electric Company was closed a few days ago, when a $600,000 order for electrical equipment and material was received as the result of competition with several foreign companies. The order is from several Italian cities, one of which is understood to be Turin. The negotiations with the American company have been under way for six months.

Duties on goods imported into Russia have been increased by 50 per cent, all customs dues being now collected on the basis of the new currency rouble, 15 of which (equal sixty-six and two-thirds copecks gold each) are equal to one imperial. In effect, however, no alteration has taken place in the amount of duty payable, the English equivalent of the rouble being now two shillings one and one-third pence, or in American money, fifty and one-tenth cents.

The Corporation of Melbourne, Australia, invites tenders for the supply and delivery of the necessary plant, and the superintendence of its erection, and of the carrying out of the work in connection with the electric lighting of the city, to specifications as follows: (1) boilers (dry-back or water-tube type, with superheaters) and economizer; (2) steam-engines, dynamos, equalizer, booster and switchboard; (3) feeders, mains and arc light leads, with all bitumen or insulating material; (4) accumulators. Specifications, etc., can be obtained from the Agent-General for Victoria, 15 Victoria street, Westminster, London, S. W., on payment of £1 1s. for each specification, to be returned on receipt by the Corporation of a bona fide tender, by March 1, 1900.

INDUSTRIAL NOTES

The Electric Appliance Company, Chicago, is sending out upon application pamphlets describing the Adams-Bagnall enclosed arc lamp.

The Transport McPherson, which sailed recently for the Philippines, had a 40-inch blower for ventilation, equipped with a direct-connected Lundell motor, by the Sprague Electric Company, of New York.

M. I. Vought, La Crosse, Wis., manufacturer of electrical specialties, has issued an attractive and unusually novel circular, showing pictorially the "two-balls" adjustable hanger for incandescent lamps.

The Central Electric Company, Chicago, is pleased with the volume of sales of Okonite wires and products for the past year. While these lines have an advantage in being pioneers in conductor insulation, yet the facts that they are precisely as represented, and free from disappointment, have greater weight with buyers.

The stockholders of the Bryant Electric Company, of Bridgeport, Ct., have purchased the Perkins Electric Switch Manufacturing Company, of Hartford, Ct. The Bryant and Perkins companies, therefore, while they will be operated as separate concerns, will be controlled by the same set of stockholders. Both companies are manufacturers of electric light supplies and specialties.

The Federal Battery Company, of New York, announce that they are extending their works and will soon be in shape to manufacture their Federal salt dry battery. The manufacturers claim that it is non-polarizing, and has a voltage of 17 to 175, and about 15 amperes, and that it will do an immense amount of work and recuperate very quickly.

The American Electric Vehicle Company, whose change of headquarters from Chicago to New York city was recently announced in the ELECTRICAL REVIEW, has leased premises for general offices and a vehicle repository at 134 West Thirty-eighth street, near the corner of Broadway, New York city, which will be ready for occupancy within a few days. The company's factory in Hoboken, N. J., is already working to its full capacity with orders in hand.

The Jewell Belting Company has made dynamo belts a special study, and their product for this service is believed to be as near perfect as has yet been attained for accomplishing steady current from dynamos. In the selection of the stock for these belts great care is taken as to uniformity in thickness so as to get steadiness and to eliminate stretching; a cement only is used in holding them together, doing away with staples, rivets or lacing. In addition to much data of this kind their catalogue contains rules for the measurement of belts in coils, rules for lacing belts, etc.

The New York Life Insurance Company have recently issued their fifty-fifth annual report which shows an enormous increase of business over any previous one. In the year 1899 alone the company announce a new business of over two million dollars, and notwithstanding this amount they issued a detailed statement of it the first week of January, 1900. The statement shows an increase in benefits to policy-holders of $687,111; in income, $6,939,346; in assets, $20,505,537; in new insurances paid for, $50,215,711; in paid for insurances in force, $117,850,865. President John A. McCall entered the New York Life in 1892, after a long experience in life insurance business. The other executive officers have had a practical experience of over twenty-five years in the actual work of the company.

An ingenious arrangement to prevent overcrowding of stairways and elevators when entering or leaving a building, is used in the main office of The International Correspondence Schools, Scranton, Pa. The time of entering and leaving the building is regulated by clocks on each of the five floors. On the lower floors the clocks are set correctly, but on the upper floors they are a few minutes slow, so that the employees on the lower floors are at their desks before those on the upper floors are due at the building. In leaving the building the employees on the upper floors do not leave their desks until several minutes later than those on the lower floors. Over 500 people are employed in the building, which is used exclusively by The International Correspondence Schools. This institution has over 70 courses of instruction by mail, and its students may be found in all parts of the world.

The Scranton Schools. The rapid growth and remarkable popularity of the schools of correspondence prove that this new system of education meets a distinct want. Starting about ten years ago with a single course in mining, The International Correspondence Schools, of Scranton, Pa., have developed so rapidly that they now teach by mail over 70 courses and have over 130,000 students on their rolls. Most of the students are residents of this country and Canada, but the schools have a large following in foreign lands. Students in 20 of the Mexican states are enrolled in the schools, and almost as many European countries are represented. That no country is too remote to be reached by the correspondence school is shown by the records of students in South Africa, Australia, Tasmania, Siam and Korea, who are successfully educating themselves through the courses of the International Correspondence Schools.

The Emerson Electric Manufacturing Company, St. Louis, have very largely increased their manufacturing capacity since last season, and will make every effort to be in a position to make prompt deliveries of desk and ceiling fans during the entire fan-motor season, now opening. The floor space of their factory has been doubled since last season, and a large quantity of improved automatic machinery has been added to their plant. The 1900 models of Emerson desk and ceiling fans will be considerably improved over the models placed on the market by them in the past. The Emerson electric fan-motor catalogue for 1900 is now in the hands of the printer, and is expected to be placed before the trade, together with net prices on fan motors and ceiling fans, about February 1, next. The indications are that the demand for Emerson product will be unusually heavy during 1900, as a large number of orders have already been booked for delivery in the United States and for export.

An Independent Toll-Station Sign.

The illustration shows a sign indicating a toll station on an independent telephone company's line. This is a standard design which has been prepared and

AN INDEPENDENT TOLL-STATION SIGN.

is being supplied by the American Electric Telephone Company, of Chicago. The sign is handsome and attractive and is adapted for attachment to any flat surface.

The Dominion Government is reported to be considering an application for foreshore privileges in Vancouver harbor from a corporation which has planned to obtain power for its proposed electricity works from the water which rushes into the harbor of Vancouver through the Narrows at nearly all stages of the tide. This project, if it can be carried out, promises not only to be unique, but to be of great value. The proposed works will be located on a point at the entrance to the harbor. About 2,000 feet of the foreshore extending out 150 feet from the narrowest part of the harbor is asked for there, and farther down at Brockton Point about the same amount of property is included in the request. Farther up, on the opposite side of the city of Vancouver, there are extensive tide flats, opposite which are the dangerous narrows. Three points are specified at different parts of the harbor, far enough apart for the tidal changes shall come at different times. If all else fails there is said to be a large stream from the mountains running through the tide lands, which of itself would be sufficient to supply all demands. With these grants as a basis, it is proposed to put in a hydro-electric plant which shall supply all the contiguous region with light and power.

ADVANCE INFORMATION

Electric Railways.

EDDYSTONE, PA.—The borough Council have passed an ordinance granting the right of way through the borough to the Delaware & Philadelphia Street Railway Company on the building of the plant.

CHESTER, PA.—The Prospect Park Street Railway Company has made a connection with the Philadelphia & Delaware line, at Essington.

BEAVER, PA.—Harry C. Eagle, Harry W. Reeves, Henry Fitzpatrick, and Charles H. A. Deens have applied for a charter for an electric street car line down the Ohio Valley. The road is to connect with the Beaver Valley Traction Company's lines at Vanport, making a continuous line from Beaver Falls, Pa., to Wellsville, Ohio, over 30 miles.

NEW YORK CITY—The New York & Nassau County Railway Company, of Long Island City has applied for a charter to operate street surface electric railroad. Capital, $150,000; incorporators: J. P. Hicks, F. Howley, D. Callahan, M. J. Smith, of New York city; J. Bermel, of Middle Village; P. J. Mears, of Flushing.

POUGHKEEPSIE, N. Y.—The New Paltz & Poughkeepsie Traction Company has been incorporated at Albany, with a capital stock of $100,000, divided into $100 shares, for the operation of the trolley road from Highland ferry to New Paltz, along the New Paltz turnpike, a distance of nine miles. The directors are: J. Wesley Supplee, W. L. Supplee and H. J. Verner, of Philadelphia, and R. E. L. Lewis, J. D. Merriam, C. W. Dayton, C. S. Carter, C. H. Stout and E. C. M. Rand, of New York.

ATLANTIC CITY, N. J.—In a short time papers will be filed at Trenton for the incorporation of another trolley in Atlantic County. A company has been formed and all the cash subscribed for the operation of a trolley line on the Shore road, between Absecon and Somer's Point to have connection with the proposed trolley line on the Pleasantville turnpike, which is to connect Atlantic City with Pleasantville. The stock subscribers are residents of Philadelphia, Atlantic City and Atlantic County. The corporation will also supply Pleasantville with electric lights, in addition to operating the trolley line.

Telephone and Telegraph.

INDIANAPOLIS, IND.—The Mugg Telephone Company was incorporated recently with a capital stock of $1,000. Lines will be built in Owen and adjoining counties. The directors are: Joseph T. Mugg, B. Frank Mugg and Thomas H. Morris.

COLUMBIA, S. C.—The Lexington Telephone Company, of Lexington, has been incorporated to operate telephone lines. Capital, $5,000; incorporators: A. Jones, of Columbia; W. P. Roof, J. Bradley, both of Lexington.

ROLFE, IOWA—The Rolfe Telephone Company, of Rolfe, has been organized to construct and operate telephone lines. Capital, $10,000; incorporators: W. Ferguson, M. Graham, C. E. Fraser, S. H. Karr, W. P. Wheeler, A. M. White, F. King, C. A. Grant, E. R. Ames, all of Rolfe.

ST. EDWARD, NEB.—St. Edward is to have a local telephone system. There will be about thirty-five 'phones to start with, to be put in by the Nebraska Telephone Company.

DENTON, DEL.—The Eastern Shore Telegraph and Telephone Company, of Caroline County, whose main office is at Denton, was organized at Ridgely recently. Officers as follows were elected: President, H. A. Richardson, Dover; vice-president, T. L. Day, Ridgely; treasurer, du Pont Walker, Dover; secretary, F. R. Owens, Denton; directors, W. H. Baker, Dover; W. R. Martin, George W. Woodford, George M. Price, Jr., and Wilbur W. Hubbard, Caroline County, and Messrs. Richardson, Day, Walker and Owens. The new company is said to control the Union Telephone Company, of which Mr. Day is president, the Cecil County telephone lines and 27 miles of telephone lines in Dorchester County. Mr. Richardson, the president of the new concern, is also president of the Diamond State Telephone Company. The new company is limited to a term of 40 years. Its capital stock is $100,000.

NEWPORT NEWS, VA.—The Newport News & Richmond Telegraph and Telephone Company has completed arrangements for laying its line between the two cities, and as soon as the company is incorporated by the legislature work will be commenced. Robert P. Orr and W. J. Nelms, of Newport News, are the principal incorporators. This line will be an important extension. It will connect with the Citizens' system of Newport News, and besides reducing the rates to Richmond, will give Newport News communication with the city of Williamsburg and all the counties of the peninsula, as well as the western shore of the Chesapeake.

Electric Light and Power.

TRENTON, N. J.—The Consolidated Railway, Electric Lighting and Equipment Company, with a capital of $16,000,000, was incorporated here recently. The company is empowered to make use of electric light and power and also to manufacture gas. The incorporators are: William W. White, New York; Frederick Rowley, Brooklyn, and Walter C. Butler, West Orange.

CLEVELAND, OHIO—An addition to the electric lighting plant owned and operated by Lakewood hamlet is contemplated. The limit of the present works has been reached and it has been necessary to refuse several requests for incandescent lamps.

HOMER, MICH.—The Village Council of Homer has decided in favor of municipal ownership of the electric lighting system. At a recent meeting of the Council a committee was appointed to purchase a plant.

ALLIANCE, NEB.—On February 1 the City Council will take permanent action regarding the establishment of an electric lighting system. Several propositions are expected.

OPELITA, ALA.—The Alabama Electric Light and Power Company, of Opelita, has been incorporated in West Virginia to do an electric light and power business. Capital, $50,000; incorporators: H. S. Parsons, T. S. Parsons, H. C. Davidson, J. W. Parsons, J. S. Pou, all of Montgomery, Ala.

WILMINGTON, DEL.—The International Commercial Incandescent Light Company, of Wilmington, has been chartered to supply light, heat and power. Capital, $200,000; incorporators: R. J. Goode, R. H. Wolle, M. L. Kauffman, A. S. Hartzell, all of Allentown, Pa.; G. F. Cornell, of Wilmington.

Miscellaneous.

WILMINGTON, DEL.—The American Telephone Repeater and Quad Company, of Wilmington, has been chartered for manufacturing telephone apparatus. Capital, $200,000; incorporators: L. E. Walkins, W. H. Chapin, F. W. Dickinson, F. S. Newman, all of Springfield, Mass.; G. M. Butterick, of Everett, Mass.

CHARLESTON, W. VA.—The Kitson Light and Foreign Development Company, of Charleston, has been incorporated to manufacture and deal in franchises for the production of light, heat and power. Capital, $1,000,000; incorporators: J. E. Scaggs, J. E. Chilton, H. Fry, J. E. Crew, W. Fraub, all of Charleston.

FREDERICK, MD.—The Russell Electric Mallet Company, of Frederick, has been incorporated with a capital stock of $10,000. The object of the incorporation is to develop the manufacture and sale of an invention for use by dentists in filling teeth.

SACO, ME.—The Victor Enclosure Company, of Saco, has been organized to manufacture electrical devices. Capital, $10,000; incorporators: S. A. Bemis, C. F. Munder, both of Springfield, Mass.; G. W. Vallee, F. D. Sweeten, F. E. Coward, all of Philadelphia, Pa.

DES MOINES, IOWA—The Electric Fire Engine Company of America has filed articles of incorporation with the Secretary of State. It will do business in Des Moines and its capital is $50,000. Theo. Johns, W. B. Keffer, W. Bishop, John Carmody, C. A. Blomgren are the incorporators and directors.

COLUMBUS, OHIO—Incorporation papers have been filed for a company to be known as the Electric Supply and Construction Company. The company will deal in electrical apparatus. The capitalization is for $10,000, and signed by John Coshatt, W. H. Sharp, W. H. and M. Simonton and Paul Chaney.

CLEVELAND, OHIO—The Homer Commutator Company, of Cleveland, has been incorporated for manufacturing and selling electrical machinery; capital, $25,000; incorporators, F. L. Homer, L. Hohlfelder, Jr., B. H. Husbands, F. B. Krause, A. W. Massey.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JANUARY 2, 1900.

640,192 Electric cloth cutter; F. Gardner, Chicago, Ill.

640,196 Electric-meter device; C. D. Haskins, Newton, Mass.—An electric meter, a device for opening a circuit of the meter responsive to reversal of current operating the electric meter.

640,206 Milking apparatus; D. Klein, Poughkeepsie, N. Y.

640,258 Electric heater; Foree Bain, Chicago, Ill. — A portable electric heater, a shell having at one end an incandescent-lamp socket and at the other a plug terminal adapted to be received by an ordinary incandescent-lamp socket, a second shell mounted at right angles thereto, an electric heater in said second shell and suitable connections between the plug terminal, the electric heater and the lamp socket.

640,273 Acoustic alarm system; C. Coleman, Chicago, Ill.—Consists of a foundation wall of a vault or other enclosure to be protected, a series of interconnecting acoustic tubes embedded therein, and a signaling device at the alarm station responding to sounds or vibrations in said acoustic tubes.

640,278 Multiple-signal transmitter; L. Dawson, Needham, Mass.—A circuit-operating device, a box-number wheel and a special-signal wheel and arms projecting from said circuit-operating device adapted to cooperate with both of said wheels.

640,283 Electric furnace; F. E. Hatch, Norway, Mich.

640,314 Electric transformer; J. W. Packard, Warren, Ohio.

640,316 Coin-controlled electrical apparatus; J. Patterson, Chicago, Ill.

640,335 Electric water filter; W. L. Teter, Philadelphia, Pa. — An inlet chamber, a eudiometer, the open-edged legs of which form the outlets from the inlet chamber, two electrodes arranged within the eudiometer and respectively connected with the poles of a source of electric energy and an outlet from said eudiometer communicating with the interior of the filter below the inlet.

640,363, 640,364, 640,365 Terminal for electric cables; Willard L. Candee, New York, N. Y.

640,366 Electric incandescent lamp; F. M. F. Cazin, Hoboken, N. J.

640,371 Electric fuse or cutout; L. W. Downes, Providence, R. I.—An enclosing sheath, and terminals on said sheath, a fuse link within the sheath consisting of three or more fusible wires or conductors connected in parallel between said terminals and disposed about an imaginary axis at equal distances from each other, an air space within the sheath traversed by said fusible wires, and a filling of suitable porous material within the sheath.

640,374 Reflector for electric or other lights; J. C. Fleming, Philadelphia, Pa.—A reflector consisting of a plurality of concentric cones, a light-reflecting material contained in the space between said cones, upper and lower supporting devices for the latter and an intermediate connecting means for said devices.

640,386 Pneumatic transfer-tube system; S. F. Jones, New York, N. Y.

640,392 Gas engine ignition device; G. W. Lewis, Philadelphia, Pa.

640,393 Gas engine; G. W. Lewis, Philadelphia, Pa.

640,395 Gas engine ignition device; G. W. Lewis, Philadelphia, Pa.

640,404 Telephone central station apparatus and circuits; S. G. McMeen.

640,407 Thermostat; R. P. Osgood, Methuen, Mass.

640,443 Coin-operated public telephone call instrument; F. J. Glendennin, South Melbourne, Victoria—A coin chute, a tilting platform arranged under the said chute, a solenoid having two cores, one of which is connected to the said platform for tilting the latter, means for energizing the said solenoid, bell-ringing devices actuated by the line circuit, which is closed by the other core of the said magnet.

640,465 Incandescent lamp; E. W. Gillmore, Warren, Ohio.

640,466 Rate-indicator for electric currents; J. Harris, Albany, N. Y.—Consists of a scale and an indicator and having means whereby the indicator is caused to indicate on the scale successively each predetermined maximum of current reached.

640,478 Lightning arrester; J. M. Metcalf, Glen Haven, Wis.

640,479 Connector for battery-electrodes, fuses, etc.; W. Mills, Elizabeth, N. J.—A carbon electrode having a flat portion or lug with slot extended wholly through the same, a connector comprising a piece of spring-wire bent to form a series of adjacent coils and provided with normally-extended spring-arms fitted elastically within such slot.

640,482 Junction box; T. J. Murphy, New York, N. Y.—A junction box comprising a base, a collapsible outer box and a collapsible inner box.

640,515 Art of distributing electrical energy by alternating currents; M. I. Pupin, New York, N. Y.—A common conductor, exciting-circuits, means for generating electro-motive forces of different periodicities acting on the exciting-circuits, there being a generator of one of the electro-motive forces in each exciting-circuit, and means for tuning each exciting-circuit, independently of the other exciting-circuits, to the periodicity of that electro-motive force which it conveys to the common conductor.

640,516 Electrical transmission by resonance-circuits; M. I. Pupin, New York, N. Y.

640,532 Terminal for cables; J. N. Byers, Urbana, Ohio.

640,533 Cable-terminal; W. Callahan, Toledo, Ohio.

640,565 System of electrical distribution; A. S. Hubbard, Belleville, N. J.

645,575 Molding or trough for electric wires; H. Lee, Chicago, Ill.—A molding for electric wires having grooves therein, and removable plugs fitting over said grooves for holding the wires in place while being strung.

640,603 Field magnet; M. S. Towson, Cleveland, Ohio—A frame having two separate sets of laminations secured therein and means for securing said frame in place, the said securing means passing into said frame between the sets of laminations.

640,618 Telephone-exchange system; T. P. Ahern, Detroit, Mich.

640,688 Speed-governor attachment for electrical apparatus; J. H. McGurty, Jersey City, N. J.

640,694 Apparatus for producing electric discharges; M. Otto, Neuilly-sur Seine, France.

640,717 Electrolytic apparatus for extracting precious metals; C. P. Tatro, Seattle, Wash.

640,727 Element for electric batteries; F. R. Wiley, Malden, Mass.

640,729 Electric lamp; W. A. Fenner, Providence, R. I.

ISSUED JANUARY 9, 1900.

640,744 Lightning arrester; C. C. Chinn, Canton, Mo.—Consists of a ground-plate, of discharge-plates adjacent thereto and adapted to discharge to the ground-plate and a fuse connected with the discharge-plates and lying adjacent the ground-plate and adapted to discharge thereto.

640,747 Electric motor; O. F. Conklin, Springfield, Ohio.

640,748 Electric motor and circuit therefor; O. F. Conklin, Springfield, Ohio—A plurality of motors connected in series, the field coils of which are always in circuit, and a switch for each motor, for throwing into and out of the circuit the armature of said motor, and a resistance equal to the impedance of said armature adapted to be thrown into circuit when said armature is thrown out.

640,749 Controller-operating mechanism; W. H. Conrad, Philadelphia, Pa.—Consists of the controller cylinder and its shaft, means for locking said shaft and cylinder against movement in one direction and mechanism controlled by the travel of the vehicle for releasing said locking means.

640,753 Device for indicating condition of storage batteries; H. F. Cuntz, Hartford, Ct.—Consists of a voltmeter and an electro-magnetic device wound to respond to differences in the amperage and operatively connected with the voltmeter to control its operation.

PATENTS.

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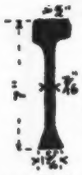

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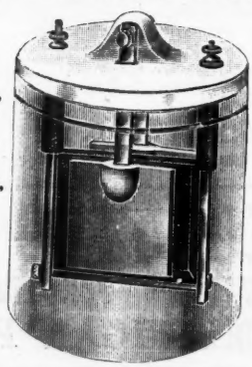

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